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UNIT LOAD
AVIATION RESUPPLY PALLET
(ULARP) TESTING

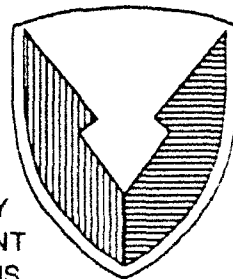
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Prepared for:
Project Manager, Ammunition Logistics
ATTN: AMCPM-AL
Picatinny Arsenal, NJ 07806-5000

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U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL
 VALIDATION ENGINEERING DIVISION
 SAVANNA, IL 61074-9639

REPORT NUMBER 91-09
 UNIT LOAD AVIATION RESUPPLY PALLET (ULARP) TESTING

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PART 1

INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center and School (USADACS) was tasked by the Project Manager, Ammunition Logistics (PM-AMMOLOG), AMCPM-AL, to develop and test helicopter resupply loads on the Unit Load Aviation Resupply Pallet (ULARP) for the Cobra, Apache, Comanche, and Kiowa helicopters. Eleven helicopter loads were developed and tested utilizing a 10,000-pound load capacity, 108- by 88-inch INTEX pallet, and a 5,000-pound load capacity, 88- by 54-inch half-size 463L pallet. The testing performed on each helicopter load consisted of a cargo net sling test, a 10 degree incline unloading test, and a road hazard transportability test. Additionally, a MIL-STD-209H, Military Standard Slings and Tiedown Provisions for Lifting and Tying Down Military Equipment, pull test was performed on a 2.75-inch rocket pallet at the request of the tasker.

B. AUTHORITY. The test was accomplished IAW mission responsibilities delegated by AMCCOM. Reference is made to the following:

1. Change 4, 4 October 1974, to AR740-1, 23 April 1973, Storage and Supply Activity Operation.
2. AMCCOM-R 10-17, Mission and Major Functions of USADACS, 13 January 1986.

C. OBJECTIVE. The objective of these tests was to determine if the aviation resupply loads developed at USADACS were adequate for safe aerial transportation of resupply commodities for cited helicopters.

D. CONCLUSIONS.

1. The basic aviation resupply loads developed by USADACS successfully passed the cargo net sling test, the 10 degree incline unloading test, and the USADACS road hazard transportability tests.

2. The 2.75-inch rocket pallet successfully passed the MIL-STD-209H pull test with minor deformation to the pallet top lift assembly. No damage was sustained by any of the rocket containers.

E. APPROVAL. As tested, the basic aviation resupply loads developed by USADACS met the load and tiedown requirements for internal aerial transport via Chinook helicopters. Also, USADACS recommends that both the ULARP loads and the 2.75-inch pallet be approved for external slinging. Final approval of external slinging is not within USADACS authority. It is the responsibility of U.S. Army Natick Research, Development and Engineering Center (NRDEC).

PART 2

ATTENDEES

Quinn D. Hartman
General Engineer
DSN 585-8992
815-273-8992

Director
U.S. Army Defense Ammunition Center
and School
ATTN: SMCAC-DEV
Savanna, IL 61074-9639

John D. Simons
Industrial Engineer
DSN 585-8074
815-273-8074

Director
U.S. Army Defense Ammunition Center
and School
ATTN: SMCAC-DET
Savanna, IL 61074-9639

PART 3

TEST PROCEDURES

Three separate tests were performed on the ULARP loads.

A. SLING TEST. The sling test was performed to determine the suitability of the ULARP load for helicopter sling transport. The sling test involved placing a cargo net sling on the loaded pallet and then lifting the pallet up with a lifting device. The cargo net sling was placed on top of the pallet load and attached to the pallet tiedown anchors. During the lift, each pallet was checked for levelness and damage. This test was only performed on the full size INTEX pallet loads.

B. INCLINE UNLOADING TEST. The incline unloading test was performed to determine if the ULARP loads would withstand an inclined unloading from a Chinook helicopter. The test was performed utilizing a Palletized Loading System (PLS) truck, a PLS flatrack, and four sections of roller conveyer. After securing the conveyers to the PLS flatrack, the ULARP was placed on the conveyer and secured to the flatrack utilizing a quick release hook. The flatrack was then elevated to a 10 degree angle with respect to the ground. Next, the quick release hook was tripped, allowing the pallet to roll approximately 10 feet down the flatrack where it struck the ground one foot below the flatrack end. Just prior to striking the ground, the PLS truck started to pull forward at a rate of approximately 3 mph until the trailing end of the pallet dropped off the flatrack and fell to the ground. At the completion of the test, the ULARP load was inspected for excessive shifting and damage.

C. TRANSPORTABILITY TESTING.

Five separate road testing steps were required as identified herein:

1. Step 1: This step provided for the specimen to be driven over a 200-foot-long segment of concrete-paved road which consisted of two series of railroad ties projecting 6 inches above the level of the road surface. This hazard course was traversed two times and repeated per step no. 4.

(a) The first series of ties was spaced on 8-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.

(b) Following the first series of ties, a paved roadway of 75 feet separated the first and second series of railroad ties.

(c) The second series of ties was alternately positioned similarly to the first, but spaced on 10-foot centers for a distance of 50 feet.

(d) The specimen load was driven across the hazard course at speeds that produced the most violent vertical and side-to-side rolling reaction obtainable in traversing the hazard course (approximately 5 miles per hour [mph]).

2. Step 2: This step consisted of 30 miles of travel over available rough roads consisting of gravel, concrete and asphalt, curves, cattle gates, and stops and starts.

3. Step 3: This step provided for the specimen load to be subjected to three full air brake stops while traveling in the forward direction and one in the reverse direction while traveling down a 7 percent grade. The first three stops were at speeds of 5, 10, and 15 mph, while the stop in the reverse direction was at approximately 5 mph.

4. Step 4: This step consisted of a repeat of that identified in step no. 1.

5. Step 5: This step provided for the specimen load to be driven over a 300-foot-long segment of concrete-paved road which had rails spaced on 26 1/2-inch centers and protruded 2 inches above the road surface. The specimen load was driven at the speed which produced the most violent response.

Note: steps nos. 3 and 5 may be deleted at the discretion of the test conductor.

6. Inspections and data collection. At selected intervals during testing, thorough inspections of the specimen loads were made by technically proficient personnel to collect data on the specimen load and equipment resulting from above load test steps. This data are recorded in part 4, following.

PART 4

TEST RESULTS

A. SYNOPSIS OF TEST NO. 1. In test no. 1, Apache Load 1 was tested on the full size INTEX pallet. Apache Load 1 consisted of 17 each 30mm ammunition containers and 16 each HELLFIRE missile containers. The initial Apache Load 1 was only tested on the road hazard transportability course due to a design change. While there were several inches of movement in the load during road hazard transportability testing, the containers remained secure to the pallet throughout the test. Approval was not granted to this particular Apache Load 1 because of a design change.

Road Test Data from Test No. 1

Date: 27 June 1991

ULARP Apache Load 1:

Load weight: 7,165 pounds.

Transportability Test:

Pass 1, Course A: 6.23 SEC, 5.47 MPH.

Pass 1, Course B: 5.88 SEC, 5.80 MPH.

Remarks: At the end of the first pass, the 30mm ammunition containers had shifted left 2 inches and forward 1-1/4 inches. The HELLFIRE containers had shifted forward 1-3/4 inches and left 1/2-inch. The angled web straps overtop of the 30mm ammunition containers were loosened.

Pass 2, Course A: 6.19 SEC, 5.51 MPH.

Pass 2, Course B: 5.60 SEC, 6.10 MPH.

Remarks: At the end of the second pass, the 30mm ammunition containers had shifted right 1/2-inch and forward 2 inches. The HELLFIRE containers had shifted forward 3/4-inch and right 1-inch. The angled web straps overtop of the 30mm ammunition containers remained loose.

30-Mile Road Test: The 30-mile road test resulted in the 30mm ammunition containers shifting left 1/4-inch and forward 1/8-inch. There was no additional movement of the HELLFIRE containers. The angled web straps overtop of the 30mm ammunition containers were starting to slip off of the container tops.

Panic Stops: The panic stops resulted in the 30mm ammunition containers shifting forward 5/8-inch and right 1/4-inch. The HELLFIRE containers shifted forward 1/2-inch and right 1/4-inch. There was no change in the web straps overtop of the 30mm ammunition containers.

Pass 3, Course A: 6.04 SEC, 5.64 MPH

Pass 3, Course B: 5.36 SEC, 6.36 MPH

Remarks: At the end of the third pass, the 30mm ammunition containers had shifted forward 1/4-inch. The HELLFIRE containers had shifted backwards 1-inch and right 1-inch. The web straps overtop of the 30mm ammunition containers had partially slid off the container tops.

Pass 4, Course A: 6.00 SEC, 5.68 MPH

Pass 4, Course B: 6.10 SEC, 5.59 MPH

Remarks: At the end of the fourth and final pass, the 30mm ammunition containers had shifted forward 1/4-inch and left 1/4-inch. The HELLFIRE containers had shifted forward 1-5/8

inches and left 1/2-inch. There was no additional movement of the web straps overtop the 30mm ammunition containers.

Washboard Course: 1.00 MIN, 3.41 MPH

Remarks: The washboard course produced no additional movement of the 30mm ammunition containers. The HELLFIRE containers shifted right 1/4-inch. There was no change in the web straps over the 30mm ammunition containers.

B. SYNOPSIS OF TEST NO. 2. In test no. 2, the modified Apache Load 1 was tested on the full size INTEX pallet. The modified Apache Load 1 consisted of the same commodities as the initial Apache Load 1; however, in a different configuration (see photos). The modified Apache Load 1 successfully passed the sling, incline unloading, and road hazard tests. Apache Load 1 met internal aerial helicopter transportation.

Road Test Data from Test No. 2

Date: 1 July 1991

Modified Apache Load 1:

Load weight: 7,165 pounds.

Sling Test: The sling test showed that the pallet and net were capable of lifting the load in a level orientation.

10 Degree Incline Unloading Test: The incline unloading test resulted in the load shifting 2-1/2 inches. All the containers on the pallet remained secure and undamaged.

Transportability Test:

Pass 1, Course A: 6.00 SEC, 5.68 MPH

Pass 1, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the first pass, the entire right side of the load had shifted 1-1/2 inches forward, while the entire left side of the load had shifted forward 2 inches. The forward HELLFIRE containers also shifted left 7/8-inch.

Pass 2, Course A: 6.00 SEC, 5.68 MPH

Pass 2, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the second pass, the entire load had shifted forward 1/2-inch. The forward HELLFIRE containers had shifted right 1 7/8-inch.

30-Mile Road Test: The 30-mile road test resulted in the forward HELLFIRE containers shifting left 2-3/4 inches and the right side of the forward containers shifted forward 1-inch. The back HELLFIRE containers shifted left 1/2-inch and the right side of the back containers shifted forward 3/4-inch.

Panic stops: The panic stops resulted in the right side of the forward HELLFIRE containers shifting forward 1/2-inch and the right side of the back HELLFIRE containers shifting forward 1/4-inch.

Pass 3, Course A: 6.00 SEC, 5.68 MPH

Pass 3, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the third pass, the forward HELLFIRE containers had shifted right 3/4-inch while the right side of the forward containers shifted back 1/2-inch. The back HELLFIRE containers shifted left 3/4-inch.

Pass 4, Course A: 6.00 SEC, 5.68 MPH

Pass 4, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the fourth pass, the forward HELLFIRE containers had shifted left 1/2-inch while the right side of the forward containers shifted forward 1/2-inch. The right side of the back HELLFIRE containers shifted forward 1/4-inch.

Washboard course: 60.00 SEC, 3.41 MPH

Remarks: The washboard course resulted in the forward HELLFIRE containers shifting left 1/4-inch while the right side of the forward containers shifted forward 1/4-inch. The back HELLFIRE containers shifted right 1/4-inch while the right side of the back containers shifted forward 1/4-inch.

C. SYNOPSIS OF TEST NO. 3. In test no. 3, Apache Load 2 was tested on the full size INTEX pallet. Apache Load 2 consisted of 17 each 30mm ammunition containers, 8 each HELLFIRE missile containers, and 10 each 2.75-inch rocket containers. Apache Load 2 successfully passed the sling, incline unloading, and road hazard tests. Apache Load 2 met internal aerial helicopter transportation.

Road Test Data from Test No. 3

Date: 2 July 1991

Apache Load 2:

Load weight: 5,190 pounds.

Sling Test: The sling test showed that the pallet and net were capable of lifting the load in a near level orientation.

10 Degree Incline Unloading Test: The incline unloading test resulted in the entire load shifting 1-1/2 inches. There was minor damage to the corner of one 30mm ammunition container where it impacted a tiedown anchor. All the containers remained secured to the pallet.

Transportability Test:

Pass 1, Course A: 6.00 SEC, 5.68 MPH

Pass 1, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the first pass, the HELLFIRE containers had shifted forward 1-1/2-inches and the 30mm ammunition containers shifted forward 3/4-inch. The second layer of 30mm ammunition containers also shifted back of the bottom layer of containers 1/2-inch.

Pass 2, Course A: 6.00 SEC, 5.68 MPH

Pass 2, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the second pass, the HELLFIRE containers had shifted forward 1/2-inch and the 30mm ammunition containers had shifted forward 1/4-inch. The diagonal straps overtop the 30mm ammunition containers had shifted and were close to sliding off the corners of the second layer of containers.

30-Mile Road Test: The 30-mile road test resulted in the HELLFIRE containers shifting backwards 1 1/4-inch. The 30mm ammunition containers shifted 1/4-inch forward and left 1/4-inch.

Panic Stops: The panic stops resulted in the HELLFIRE containers shifting forward 1/4-inch. There was no additional movement of the 30mm ammunition containers. The diagonal straps overtop the 30mm ammunition containers had almost slid off the corners of the second layer of containers.

Pass 3, Course A: 6.00 SEC, 5.68 MPH

Pass 3, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the third pass, the HELLFIRE containers had shifted right 1/2-inch and the 30mm ammunition containers had shifted left 1/4-inch. One of the diagonal straps overtop the 30mm ammunition containers had slipped off the corner of one of the second layer containers. The strap was loosened, but still secured the containers to the pallet.

Pass 4, Course A: 6.00 SEC, 5.68 MPH

Pass 4, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the fourth pass, no additional movement was noted for the HELLFIRE containers. The 30mm ammunition containers shifted forward 3/8-inch and right 1-inch. The strap that had slipped over the corner on the second layer of 30mm ammunition containers was close to slipping over the corner of the top layer of containers.

Washboard Course: 1.00 MIN, 3.41 MPH

Remarks: The washboard course resulted in the HELLFIRE containers shifting forward 1-inch. The 30mm ammunition containers shifted forward 3/8-inch and left 1/2-inch. The outer bottom two 30mm ammunition containers started to ride up on the tiedown anchors. The diagonal strap overtop of the 30mm ammunition containers had slipped the rest of the way off the corner of the top layer of containers. The remaining two straps overtop the 30mm ammunition containers were loosened, but were still able to secure the containers to the pallet.

D. SYNOPSIS OF TEST NO. 4. In test no. 4, Apache Load 3 was tested on the full size INTEX pallet. Apache Load 3 consisted of 38 each 2.75-inch rocket containers, and 34 each

30mm ammunition containers. Apache Load 3 successfully passed the sling, incline unloading, and road hazard tests. Apache Load 3 met internal aerial helicopter transportation.

Road Test Data from Test No. 4

Date: 8 July 1991

Apache Load 3:

Load weight: 9,750 pounds.

Sling Test: The sling test showed that the pallet and net were capable of lifting the load in a level orientation.

10 Degree Incline Unloading Test: The incline unloading test resulted in the entire load shifting 1-1/2 inches. Also, the top two layers of 30mm ammunition containers at the impact end of the pallet shifted 3 inches. No containers were damaged and the load was still secure. Prior to road hazard testing, the load was realigned.

Transportability Test:

Pass 1, Course A: 7.20 SEC, 4.74 MPH

Pass 1, Course B: 6.00 SEC, 5.68 MPH

Remarks: During the first pass, the load was noted to have shifted several inches side-to-side. At the completion of the first pass, the load was checked and had returned to the original starting position.

Pass 2, Course A: 6.00 SEC, 5.68 MPH

Pass 2, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the second pass, the load was inspected and no movement of the containers was noted.

30-Mile Road Test: The 30-mile road test resulted in the back stack of 30mm ammunition containers shifting left 1/2-inch. One of the crossed straps overtop the back 30mm ammunition containers slid off of the corner of the top layer of containers.

Panic Stops: The panic stops resulted in minor shifting of the load during each stop, but no permanent displacement of the load occurred.

Pass 3, Course A: 6.00 SEC, 5.68 MPH

Pass 3, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the third pass, the upper two layers of the front stack of 30mm ammunition containers had shifted forward 1-1/2 inches. The rear stack of 30mm ammunition containers shifted left 1-1/2 inches.

Pass 4, Course A: 6.00 SEC, 5.68 MPH

Pass 4, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the fourth pass, the rear stack of 30mm ammunition containers shifted left 1/4-inch and the 2.75-inch rocket containers shifted forward 2 inches.

Washboard Course: 1 MIN, 3.41 MPH

Remarks: The washboard course resulted in the 2.75-inch rocket containers shifting forward 1-inch. No additional movement was noted in the 30mm ammunition containers.

E. SYNOPSIS OF TEST NO. 5. In test no. 5, Cobra Load 2 was tested on the full size INTEx pallet. Cobra Load 2 consisted of 38 each 2.75-inch rocket containers, and 16 each 20mm ammunition containers. Cobra Load 2 successfully passed both the sling and incline unloading tests, but failed the road hazard tests. Cobra Load 2 was not approved for internal aerial helicopter transportation.

Road Test Data from Test No. 5

Date: 9 July 1991

Cobra Load 2:

Load weight: 9,100 pounds.

Sling Test: The sling test showed that the pallet and net were capable of lifting the load in a level orientation.

10 Degree Incline Unloading Test: The incline unloading test resulted in the entire load shifting 1-1/2 inches, two 20mm ammunition containers from the second layer of containers shifted 3 inches, and the upper 3 layers of 2.75-inch rocket containers shifted 3 inches. No containers were damaged and the load was still secure. Prior to road hazard testing, the load was realigned.

Transportability Test:

Pass 1, Course A: 6.00 SEC, 5.68 MPH

Pass 1, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the first pass, the 20mm ammunition containers had shifted forward 1-1/2 inches and the 2.75-inch rocket containers had shifted forward 1/2-inch. Two 20mm ammunition containers in the middle two layers of containers shifted backwards 2 inches relative to the rest of the containers.

Pass 2, Course A: 6.00 SEC, 5.68 MPH

Pass 2, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the second pass, the 20mm ammunition containers had shifted forward 1-1/2 inches and left 1/2-inch. The 2.75-inch rocket containers shifted forward 1-1/4 inches. The top layer of 20mm ammunition containers started to shift backwards from the rest of the containers. Also, the center 2.75-inch rocket containers started to shift forward from the rest of the containers.

30-Mile Road Test: The 30-mile road test resulted in no significant changes to the pallet load.

Panic Stops: The panic stops resulted in the 2.75-inch rocket containers shifting forward 1/4-inch.

Pass 3, Course A: 6.00 SEC, 5.68 MPH

Pass 3, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the third pass, the 20mm ammunition containers shifted forward 1-inch and the 2.75-inch rocket containers shifted forward 1-inch.

Pass 4, Course A: 6.00 SEC, 5.68 MPH

Pass 4, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the fourth pass, the 20mm ammunition containers shifted forward 1-inch and the 2.75-inch rocket containers shifted forward 1-inch. The top layer of 20mm ammunition containers had shifted backwards 3 inches from the rest of the containers. The center 2.75-inch rocket container had shifted 3 inches forward from the rest of the containers.

Washboard Course: 1.00 MIN, 3.41 MPH

Remarks: The washboard course resulted in the 20mm ammunition containers shifting forward 1-3/4 inches. The 2.75-inch rocket containers shifted forward 1-3/4 inches. During the test, one 20mm container from the top layer shifted all the way out of the stack of containers and fell to the trailer bed.

F. SYNOPSIS OF TEST NO. 6. In test no. 6, Cobra Load 3 was tested on the full size INTEX pallet. Cobra Load 3 consisted of 38 each 2.75-inch rocket containers and 8 each 20mm ammunition containers. Cobra Load 3 successfully passed the sling, incline unloading, and road hazard tests. Cobra Load 3 met internal aerial helicopter transportation.

Road Test Data from Test No. 6

Date: 9 July 1991

Cobra Load 3:

Load weight: 7,760 pounds.

Sling Test: The sling test showed that the pallet and net were capable of lifting the load in a level orientation.

10 Degree Incline Unloading Test: The incline unloading test resulted in the entire load shifting 1-1/2 inches. In addition, the upper three layers of 2.75-inch rocket containers shifted 3 inches relative to the other containers.

Transportability Test:

Pass 1, Course A: 6.00 SEC, 5.68 MPH

Pass 1, Course B: 6.00 SEC, 5.68 MPH

Remarks: During the test, the 2.75-inch rocket containers were noted to have been shifting several inches side-to-side. At the end of the first pass, the 2.75-inch rocket containers had shifted right 1/2-inch. No movement was noted in the 20mm ammunition containers. Two of the center 2.75-inch rocket containers had shifted forward 1-inch relative to the other containers.

Pass 2, Course A: 6.00 SEC, 5.68 MPH

Pass 2, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the second pass, the 2.75-inch rocket containers had shifted right 1/2-inch and forward 1/2-inch. The two center 2.75-inch rocket containers that shifted forward during the first pass had shifted forward again and were hanging out 2 inches relative to the other containers. No movement was noted in the 20mm ammunition containers.

30-Mile Road Test: The 30-mile road test resulted in the 2.75-inch rocket containers shifting forward 1/4-inch and right 1/4-inch. No movement was noted for the 20mm ammunition containers, and there was no additional shifting of the center 2.75-inch rocket containers that shifted forward of the other 2.75-inch rocket containers during the first two passes of the road hazard course.

Panic Stops: No changes were noted in the load following the panic stops.

Pass 3, Course A: 6.00 SEC, 5.68 MPH

Pass 3, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the third pass, the 2.75-inch rocket containers had shifted forward 1/4-inch and right 3/4-inch. No movement was noted for the 20mm ammunition containers or the center 2.75-inch rocket containers that previously shifted.

Pass 4, Course A: 6.00 SEC, 5.68 MPH

Pass 4, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the fourth pass, the 2.75-inch rocket containers had shifted forward 1/2-inch and right 1/4-inch. The 20mm ammunition containers shifted forward 1/4-inch. The center 2.75-inch rocket containers that had previously shifted forward had shifted back into line with the other containers.

Washboard course: 1.00 MIN, 3.41 MPH

Remarks: The washboard course resulted in the 2.75-inch rocket containers shifting forward 1 3/4-inch and right 1/4-inch. The 20mm ammunition containers shifted forward 1-inch. No shifting was noted on the center 2.75-inch rocket containers.

G. SYNOPSIS OF TEST NO. 7. In test no. 7, Cobra Load 1 was tested on the full size INTEx pallet. Cobra Load 1 consisted of 8 each 20mm ammunition containers, 16 TOW missile containers, and 19 each 2.75-inch rocket containers. Cobra Load 1 successfully passed the sling, incline unloading, and road hazard tests. Cobra Load 1 met internal aerial helicopter transportation.

Road Test Data from Test No. 7

Date: 11 July 1991

Cobra Load 1:

Load weight: 6,070 pounds.

Sling Test: The sling test showed that the pallet and net were capable of lifting the load in a level orientation.

10 Degree Incline Unloading Test: The incline unloading test resulted in the TOW and 2.75-inch containers shifting 1-inch. The 20mm ammunition containers shifted 2 inches. One 2.75-inch rocket container fell apart during the test. The container was judged to be in poor shape to begin with, so the test load was not failed. The damaged container was replaced prior to road hazard testing.

Transportability Test:

Pass 1, Course A: 6.00 SEC, 5.68 MPH

Pass 1, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the first pass, the TOW containers had shifted forward 1-inch and left 1/4-inch. The 2.75-inch rocket containers shifted forward 1-inch and the 20mm ammunition containers shifted forward 1/2-inch.

Pass 2, Course A: 6.00 SEC, 5.68 MPH

Pass 2, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the end of the second pass, the TOW containers had shifted forward 1/2-inch and left 1/4-inch. The 2.75-inch rocket containers shifted forward 1/4-inch. No additional movement was noted for the 20mm ammunition containers.

30-Mile Road Test: At the completion of the 30-mile road test, the load was examined with no movement noted.

Panic Stops: At the completion of the panic stops, the load was examined with no movement noted.

Pass 3, Course A: 6.00 SEC, 5.68 MPH

Pass 3, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the completion of the third pass, the TOW containers had shifted forward 5/8-inch and the 2.75-inch rocket containers shifted forward 1/2-inch. The 20mm ammunition containers shifted forward 1/4-inch and left 1/2-inch.

Pass 4, Course A: 6.00 SEC, 5.68 MPH

Pass 4, Course B: 6.00 SEC, 5.68 MPH

Remarks: At the completion of the fourth pass, the TOW containers had shifted forward 1/4-inch and the 2.75-inch rocket containers had shifted forward 1/2-inch. The 20mm ammunition containers shifted backwards 1/4-inch.

Washboard Course: 1.00 MIN, 3.41 MPH

Remarks: The washboard course resulted in the TOW containers shifting forward 3/8-inch. No additional movement was noted for the 2.75-inch rocket containers or the 20mm ammunition containers.

H. SYNOPSIS OF TEST NO. 8. In test no. 8, a modified Cobra Load 2 was tested on the full size INTEX pallet. The modified Cobra Load 2 consisted of the same commodities as the original Cobra Load 2. The modified Cobra Load 2 successfully passed the sling, incline unloading, and road hazard tests. Modified Cobra Load 2 met internal aerial helicopter transportation.

Road Test Data from Test N . 8

Date: 14 November 1991

Cobra Load 2:

Load weight: 9,100 pounds.

Sling Test: The sling test showed that the pallet and net were capable of lifting the load in a level orientation.

10 Degree Incline Unloading Test: The incline unloading test resulted in the 20mm ammunition containers shifting 1-1/2 inches and the 2.75-inch rocket containers shifting 1/2-inch.

Transportability Test:

Pass 1, Course A: 5.76 SEC, 5.92 MPH

Pass 2, Course B: 5.80 SEC, 5.88 MPH

Remarks: At the end of the first pass, the entire load had shifted backwards 1/2-inch.

Pass 2, Course A: 5.60 SEC, 6.09 MPH

Pass 2, Course B: 5.33 SEC, 6.40 MPH

Remarks: At the end of the second pass, no additional shifting was noted in the bottom rows of containers. The upper containers in the stacks of 2.75-inch rocket containers had shifted together causing the two straps that travel overtop of all the 2.75-inch rocket containers to loosen.

30-Mile Road Course: The 30-mile road course resulted in the 20mm ammunition containers shifting left 1-inch.

Panic Stops: No movement was noted in the load following the completion of the panic stops.

Pass 3, Course A: 5.55 SEC, 6.14 MPH

Pass 3, Course B: 5.74 SEC, 5.94 MPH

Remarks: At the completion of the third pass, the 20mm ammunition containers had shifted forward 1/2-inch and left 1/2-inch. The forward column of 2.75-inch rocket containers had shifted forward 1/2-inch.

Pass 4, Course A: 5.69 SEC, 6.00 MPH

Pass 4, Course B: 5.70 SEC, 5.98 MPH

Remarks: At the completion of the fourth pass, the 20mm ammunition containers had shifted left 1/2-inch. No movement was noted for the 2.75-inch rocket containers.

Washboard Course: 61.73 SEC, 3.31 MPH

Remarks: The washboard course resulted in the 20mm and 2.75-inch rocket containers shifting forward 1/4-inch.

I. SYNOPSIS OF TEST NO. 9. In test no. 9, Comanche Load 2 was tested on the full size INTEX pallet. Comanche Load 2 consisted of 30 each 2.75-inch rocket containers and 8 each 20mm ammunition containers. Comanche Load 2 successfully passed the sling, incline unloading, and road hazard tests. Comanche Load 2 met internal aerial helicopter transportation.

Road Test Data from Test No. 9

Date: 4 February 1992

Comanche Load 2:

Load weight: 6,100 pounds.

Sling Test: The sling test showed that the pallet and net were capable of lifting the load in a level orientation.

10 Degree Incline Unloading Test: The incline unloading test resulted in the load shifting 1-inch. The load attachment method caused the center 20mm ammunition containers to shift forward while the outer edge of the outer containers stayed in place as the web straps were run through the handles of the containers.

Pass 1, Course A: 5.67 SEC, 6.01 MPH

Pass 1, Course B: 6.14 SEC, 5.55 MPH

Remarks: At the end of the first pass, the 20mm ammunition containers had shifted left 1/2-inch. The back stack of 2.75-inch rocket containers had shifted back 1-inch and left 1-1/2 inches. The front stack of 2.75-inch rocket containers shifted back 1/2-inch. Several straps overtop the 2.75-inch rocket containers slid between the boxes causing the straps to loosen.

Pass 2, Course A: 5.69 SEC, 5.99 MPH

Pass 2, Course B: 5.65 SEC, 6.03 MPH

Remarks: At the end of the second pass, the 20mm ammunition containers had shifted forward 1/4-inch and left 1/4-inch. The back stack of 2.75-inch rocket containers had shifted backwards 1/4-inch and left 3/4-inch. The forward stack of 2.75-inch rocket containers shifted left 1/2-inch.

30-Mile Road Course: No movement was noted in the load at the completion of the 30-mile road course.

Panic Stops: The panic stops resulted in the back stack of 2.75-inch rocket containers shifting backwards 1/4-inch and right 3/4-inch. The front stack of 2.75-inch rocket containers shifted backwards 1/4-inch. No movement was noted for the 20mm ammunition containers.

Pass 3, Course A: 5.56 SEC, 6.13 MPH

Pass 3, Course B: 5.35 SEC, 6.37 MPH

Remarks: At the end of the third pass, the 20mm ammunition containers had shifted left 1/4-inch. No movement was noted for the back 2.75-inch rocket containers. The front stack of 2.75-inch rocket containers had shifted forward 3/4-inch and right 1/2-inch.

Pass 4, Course A: 5.55 SEC, 6.14 MPH

Pass 4, Course B: 5.53 SEC, 6.17 MPH

Remarks: At the end of the fourth pass, the back stack of 2.75-inch rocket containers had shifted left 1-1/4 inches. No additional movement was noted for the 20mm ammunition containers or the front 2.75-inch rocket containers.

Washboard Course: 34 SEC, 6.01 MPH

Remarks: The washboard course resulted in the 20mm ammunition containers shifting backwards 1/4-inch and right 1/4-inch. The back stack of 2.75-inch rocket containers shifted forward 1-inch and right 3/4-inch. The front stack of 2.75-inch rocket containers shifted back 1/4-inch and left 1-inch.

J. SYNOPSIS OF TEST NO. 10. In test no. 10, Comanche Load 1 was tested on the full size INTEX pallet. Comanche Load 1 consisted of 15 HELLFIRE containers, 6 STINGER containers, 8 each 20mm ammunition containers, and 3 argon bottle containers. Comanche

Load 1 successfully passed the sling, incline unloading, and road hazard tests. Comanche Load 1 was approved for internal aerial helicopter transportation.

Road Test Data from Test No. 10

Date: 5 February 1992

Comanche Load 1:

Load weight: 4,710 pounds.

Sling Test: The sling test showed that the pallet and net were capable of lifting the load in a level orientation.

10 Degree Incline Unloading Test: The incline unloading test resulted in the load shifting 1-inch. All containers remained secured to the pallet and undamaged.

Pass 1, Course A: 5.50 SEC, 6.20 MPH

Pass 1, Course B: 5.82 SEC, 5.86 MPH

Remarks: At the end of the first pass, the load had shifted left 1/2-inch.

Pass 2, Course A: 5.50 SEC, 6.20 MPH

Pass 2, Course B: 5.69 SEC, 6.00 MPH

Remarks: At the end of the second pass, the load had shifted left 3/4-inch. The front HELLFIRE containers also shifted back 1/2-inch.

30-Mile Road Course: The 30-mile road course resulted in the front HELLFIRE containers shifting back 1/4-inch and right 1/2-inch. The back HELLFIRE containers shifted right 1/4-inch.

Panic Stops: No additional movement was noted in the load following the panic stops.

Pass 3, Course A: 5.56 SEC, 6.13 MPH

Pass 3, Course B: 5.75 SEC, 5.93 MPH

Remarks: At the end of the third pass, the front HELLFIRE containers had shifted left 1/2-inch and the back HELLFIRE containers had shifted forward 1/4-inch and left 1/2-inch.

Pass 4, Course A: 5.55 SEC, 6.14 MPH

Pass 4, Course B: 5.63 SEC, 6.06 MPH

Remarks: At the end of the fourth pass, the front HELLFIRE containers had shifted backwards 1/4-inch and right 3/4-inch. The back HELLFIRE containers shifted backwards 1/2-inch and right 1/4-inch.

Washboard Course: 59.24 SEC, 3.45 MPH

Remarks: The washboard course resulted in the front HELLFIRE containers shifting left 1/4-inch and the back HELLFIRE containers shifting backwards 1/4-inch.

K. SYNOPSIS OF TEST NO. 11. In test no. 11, Kiowa Load 1 was tested on a half-size 463L pallet. Kiowa Load 1 consisted of six STINGER containers, six 2.75-inch rocket containers, and three argon bottle containers. Kiowa Load 1 successfully passed the incline unloading and road hazard tests. Kiowa Load 1 was approved for internal aerial helicopter transportation.

Road Test Data from Test No. 11

Date: 5 February 1992

Kiowa Load 1:

Load weight: 1,685 pounds.

10 Degree Incline Unloading Test: The incline unloading test resulted in the load shifting 1/2-inch. All containers remained secured to the pallet and undamaged.

Pass 1, Course A: 5.47 SEC, 6.23 MPH

Pass 1, Course B: 5.73 SEC, 5.95 MPH

Remarks: At the end of the first pass, the load shifted forward 1/2-inch and right 1-inch.

Pass 2, Course A: 5.65 SEC, 6.03 MPH

Pass 2, Course B: 5.66 SEC, 6.02 MPH

Remarks: At the end of the second pass, the load shifted forward 1/2-inch and right 1/4-inch.

30-Mile Road Course: No additional load movement was noted at the end of the 30-mile road course.

Panic Stops: No additional load movement was noted at the end of the panic stops.

Pass 3, Course A: 5.48 SEC, 5.58 MPH

Pass 3, Course B: 5.68 SEC, 5.78 MPH

Remarks: At the end of the third pass, no additional load movement was noted.

Pass 4, Course A: 5.54 SEC, 6.15 MPH

Pass 4, Course B: 5.79 SEC, 5.89 MPH

Remarks: At the end of the fourth pass, the load had shifted forward 1/4-inch.

Washboard Course: 59.49 SEC, 3.46 MPH

Remarks: No additional load movement was noted at the end of the washboard course.

L. SYNOPSIS OF TEST NO. 12. In test no. 12, Kiowa Load 2 was tested on a half-size 463L pallet. Kiowa Load 2 consisted of 6 HELLFIRE containers and 15 each .50 caliber ammunition containers. Kiowa Load 2 successfully passed the incline unloading and road hazard tests. Kiowa Load 2 met internal aerial helicopter transportation.

Road Test Data from Test No. 12

Date: 6 February 1992

Kiowa Load 2:

Load weight: 1,920 pounds.

10 Degree Incline Unloading Test: The incline unloading test resulted in the load shifting 1-3/4 inches. All containers remained secured to the pallet and undamaged.

Pass 1, Course A: 5.73 SEC, 5.95 MPH

Pass 1, Course B: 5.60 SEC, 6.09 MPH

Remarks: At the end of the first pass, the load had shifted backwards 3/4-inch and right 2 inches.

Pass 2, Course A: 5.50 SEC, 6.20 MPH

Pass 2, Course B: 5.83 SEC, 5.85 MPH

Remarks: At the end of the second pass, the load was inspected with no additional movement noted.

30-Mile Road Course: The 30-mile road course resulted in the load shifting left 1/4-inch.

Panic Stops: No additional load movement was noted at the completion of the panic stops.

Pass 3, Course A: 5.48 SEC, 6.22 MPH

Pass 3, Course B: 5.64 SEC, 6.04 MPH

Remarks: At the end of the third pass, the load was inspected and no movement was noted.

Pass 4, Course A: 5.58 SEC, 6.11 MPH

Pass 4, Course B: 5.59 SEC, 6.10 MPH

Remarks: At the end of the fourth pass, the load had shifted backwards 1/4-inch.

Washboard Course: 59.28 SEC, 3.45 MPH

Remarks: No movement was noted in the load following the completion of the washboard course.

M. SYNOPSIS OF TEST NO. 13. In test no. 13, Kiowa Load 3 was tested on a half-size 463L pallet. Kiowa Load 3 consisted of 6 STINGER containers, 15 each .50 caliber ammunition containers, and 3 argon bottle containers. Kiowa Load 3 successfully passed the incline unloading and road hazard tests. Kiowa Load 3 met internal aerial helicopter transportation.

Road Test Data from Test No. 13

Date: 6 February 1992

Kiowa Load 3:

Load weight: 1,380 pounds.

10 Degree Incline Unloading Test: No significant load movement was noted during the incline unloading test. At the completion of the incline unloading test, the half-size 463L pallet was noted to have failed. The bottom layer of aluminum detached from the outer metal frame along an edge of the pallet (see photos). The load was not considered a failure due to the fact that the

pallet was a modified full-size 463L pallet that was cut in half, and the pallet was in poor condition at the start of the test.

Pass 1, Course A: 5.52 SEC, 6.18 MPH

Pass 1, Course B: 5.39 SEC, 6.33 MPH

Remarks: At the end of the first pass, the load was inspected and no movement was noted.

Pass 2, Course A: 5.58 SEC, 6.11 MPH

Pass 2, Course B: 5.59 SEC, 6.10 MPH

Remarks: At the end of the second pass, no movement was detected in the load.

30-Mile Road Test: No load movement was noted at the completion of the 30-mile road test.

Panic Stops: No movement of the load was noted at the completion of the panic stops.

Pass 3, Course A: 5.57 SEC, 6.12 MPH

Pass 3, Course B: 5.56 SEC, 6.13 MPH

Remarks: At the end of the third pass, the load was inspected with no movement noted.

Pass 4, Course A: 5.50 SEC, 6.20 MPH

Pass 4, Course B: 5.63 SEC, 6.06 MPH

Remarks: At the end of the fourth pass, the load was inspected with no movement noted.

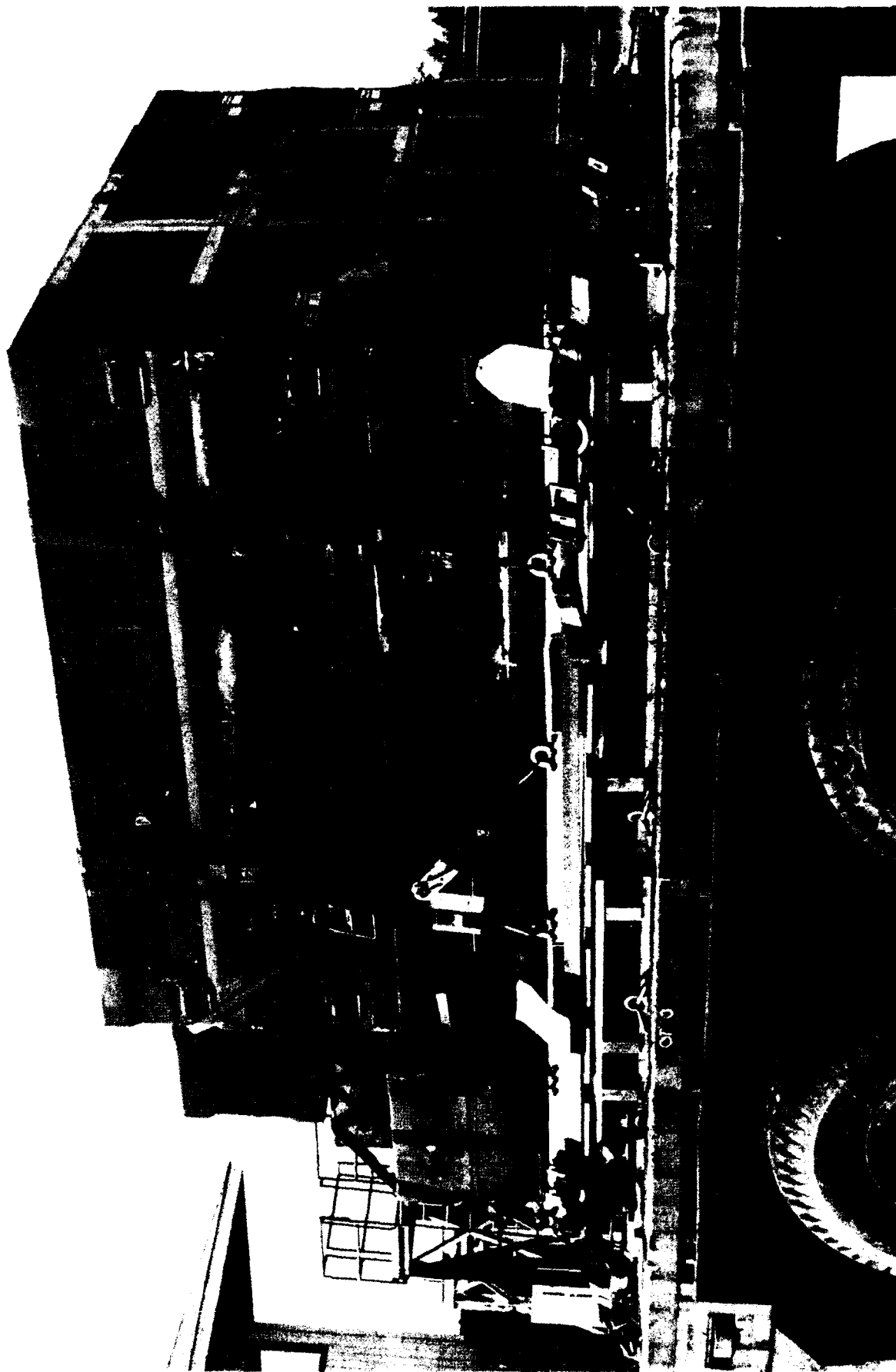
Washboard Course: 59.35 SEC, 3.45 MPH

Remarks: The washboard course resulted in no change to the load.

N. SYNOPSIS OF TEST NO. 14. In test no. 14, a MIL-STD-209H sling test was performed on a pallet of 2.75-inch rockets. The Hydra 70 sling test involves placing a static force on the toplift assembly of the pallet equal to 3.5 times the weight of the pallet. The 2.75-inch rocket pallet is 77-1/2 inches long by 29-1/4 inches wide by 43-1/2 inches high and weighs 2,500 pounds. The test pallet was secured to an M871 semitrailer with two web straps run through the pallet overtop the bottom two layers of 2.75-inch rocket containers (see photos). A 9,000-pound load was then applied to the pallet toplift via a 4-legged sling. The load force was maintained for approximately 2 minutes. The pallet toplift sustained minor deformation to the cross members which are attached to the lifting rings. There was no damage to any of the containers or the pallet base. The deformation was significant enough to prevent stacking of pallets, but in no way limited the functionality of the pallet or 2.75-inch rocket containers.

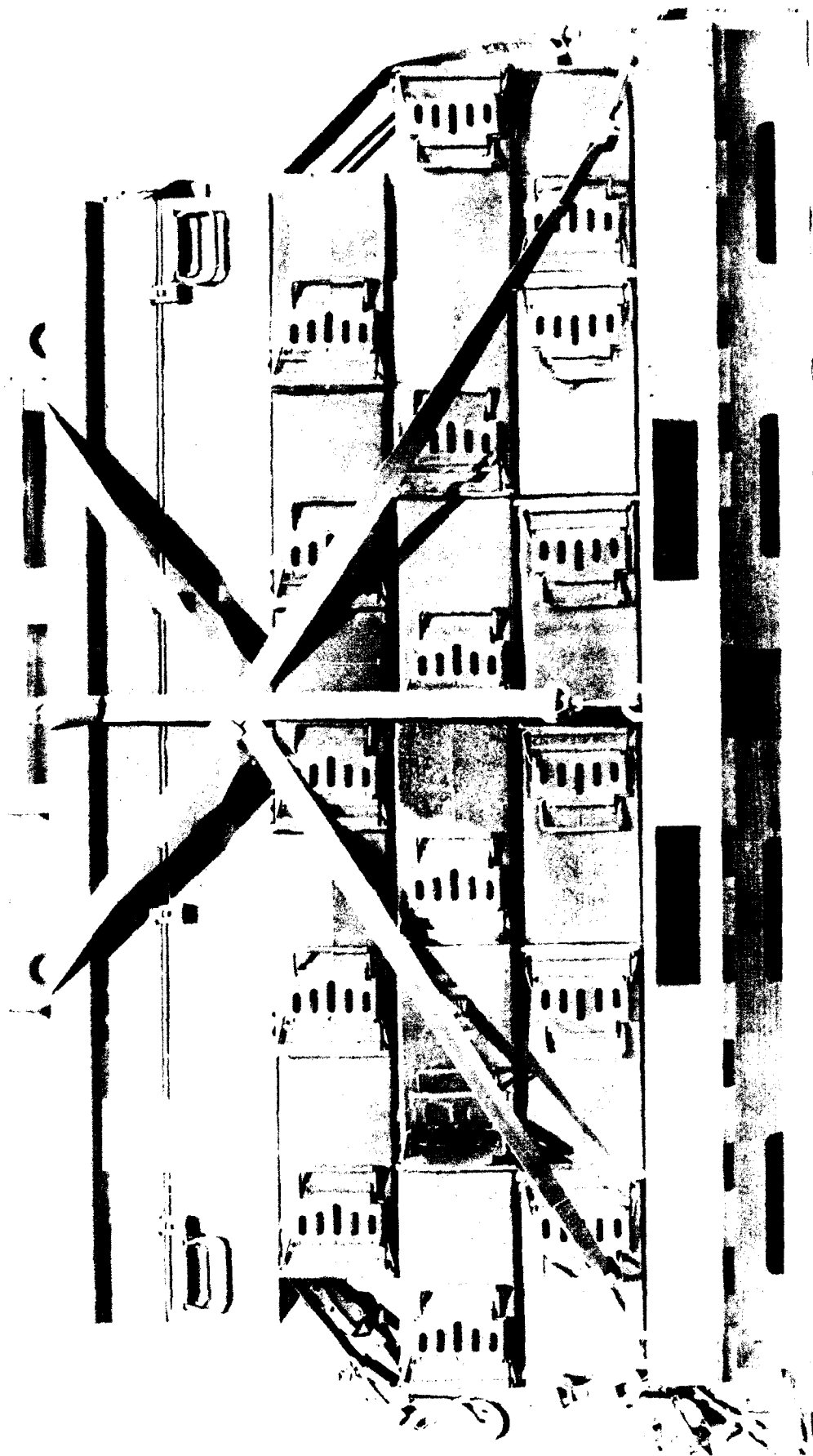
PART 5

PHOTOGRAPHS



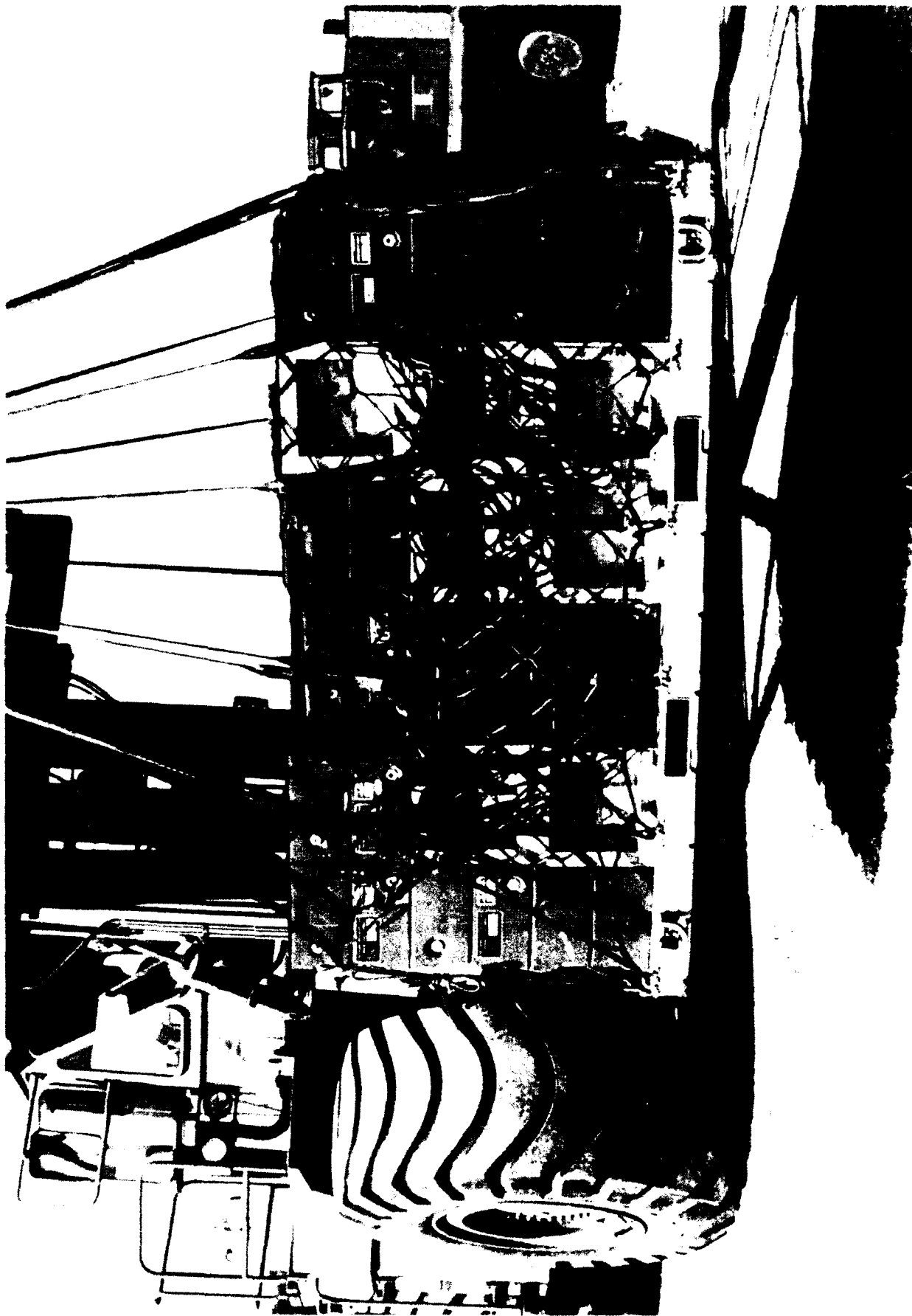
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. AO317-SCN-91-262-4165. This photograph shows Apache Load I on the M871 trailer prior to road hazard testing.



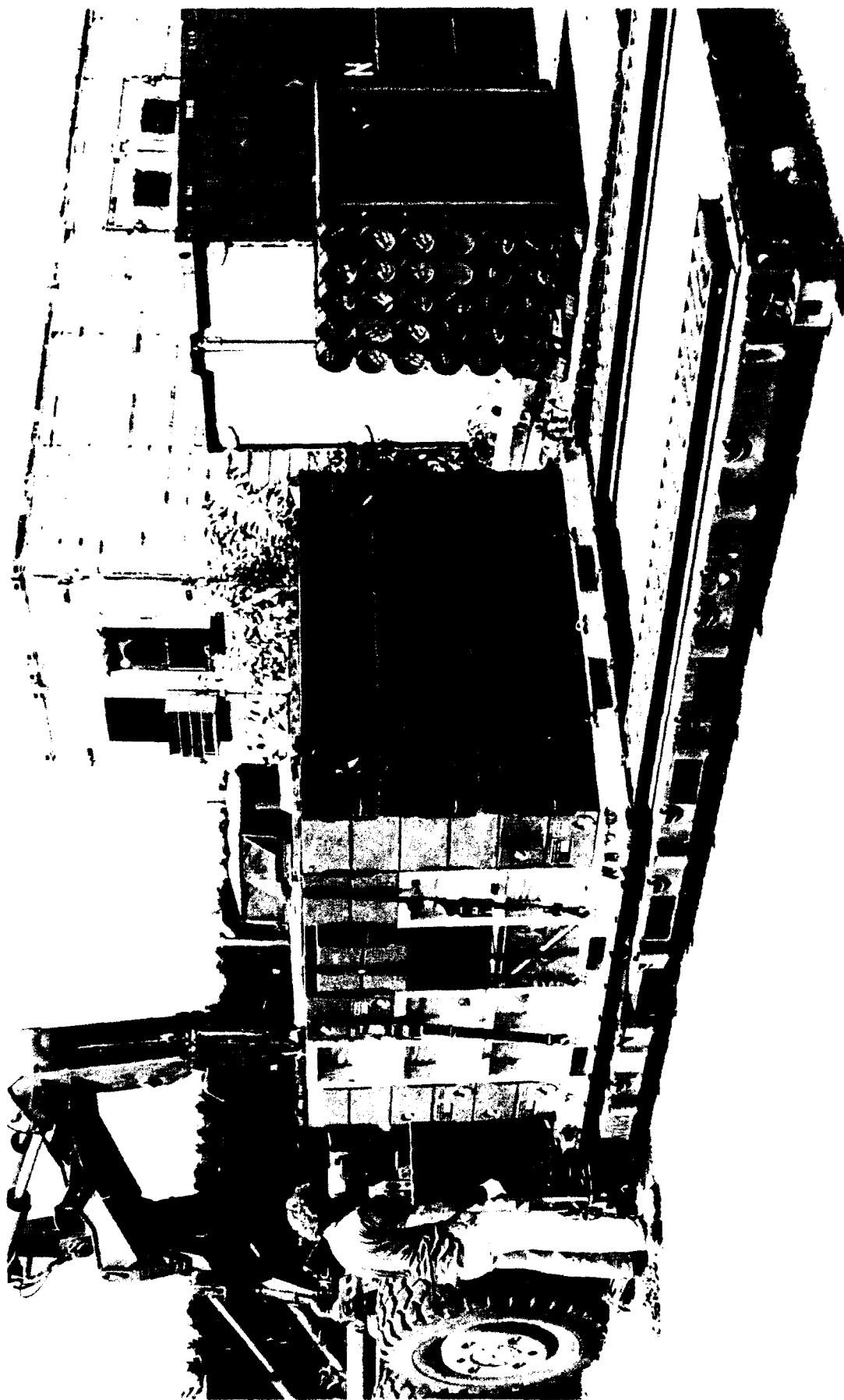
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Photo No. AO317-SCN-91-262-4154. This photograph shows an additional view of Apache Load I on the M871 trailer prior to road hazard testing.



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Photo No. AO317-SCN-91-262-4105. This photograph shows the modified Apache Load I during sling testing.



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Photo No. AO317-SCN-91-262-4108. This photograph shows the modified Apache Load I being loaded onto the PLS flatrack with conveyers prior to the 10 degree incline unloading test.



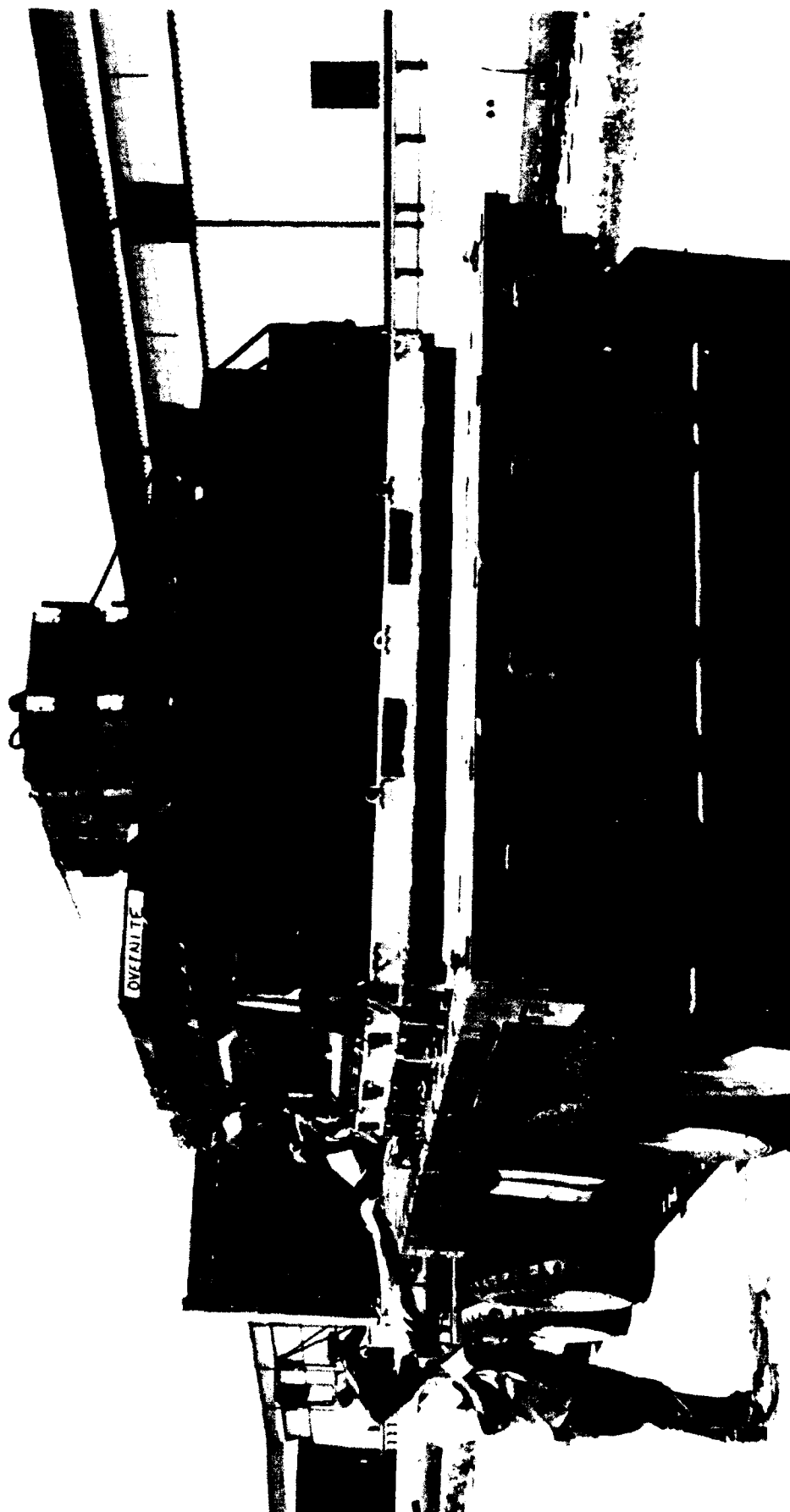
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Photo No. AO317-SCN-91-262-4111. This photograph shows Apache Load II during sling testing. Note that the pallet hangs slightly out of level.		
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Photo No. AO317-SCN-91-262-4114. This photograph shows Apache Load II just prior to striking the ground during the 10 degree incline unloading test.



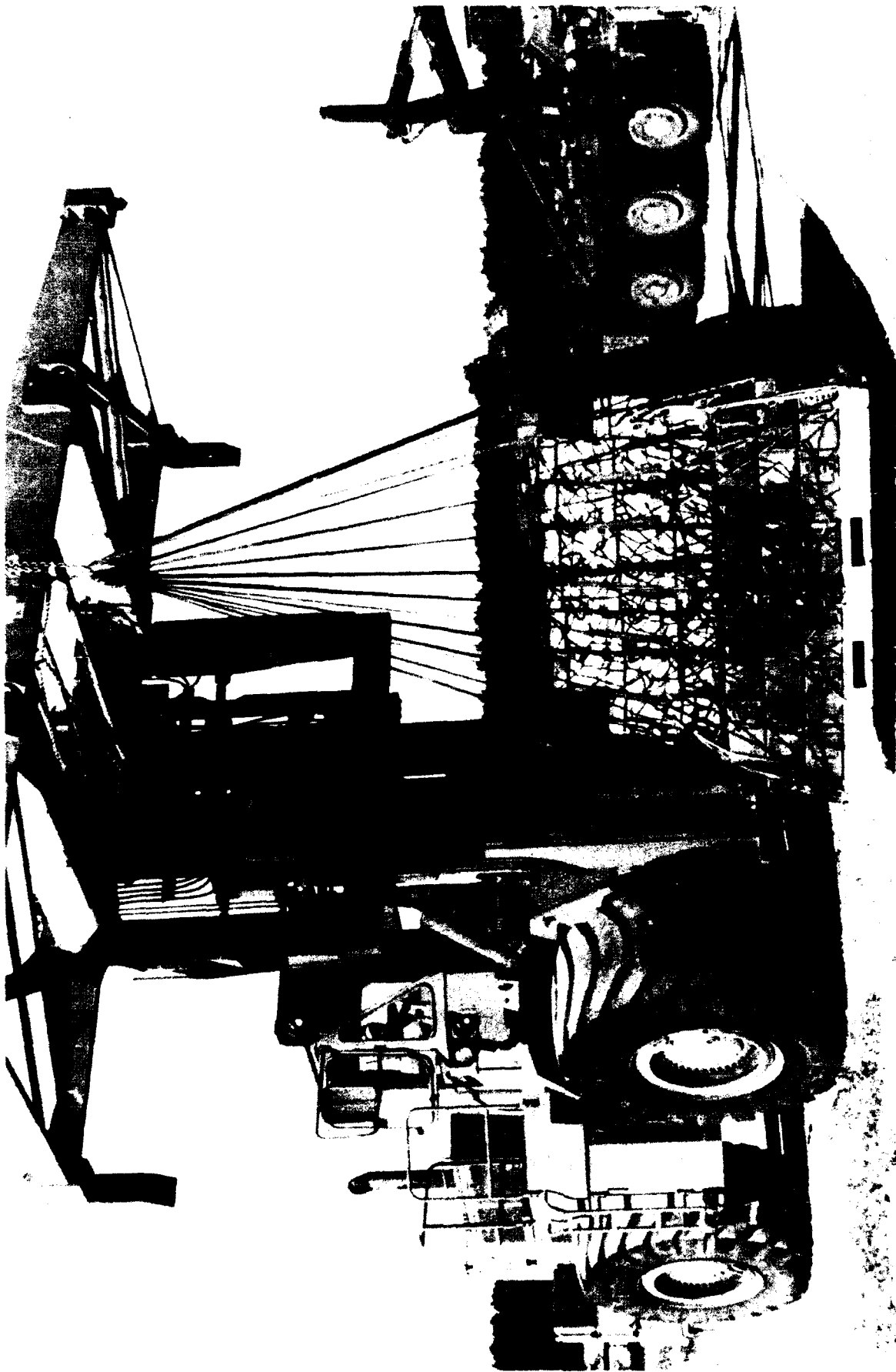
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Photo No. AO317-SPN-91-262-4047. This photograph shows Apache Load II being loaded onto the M871 trailer prior to road hazard testing.



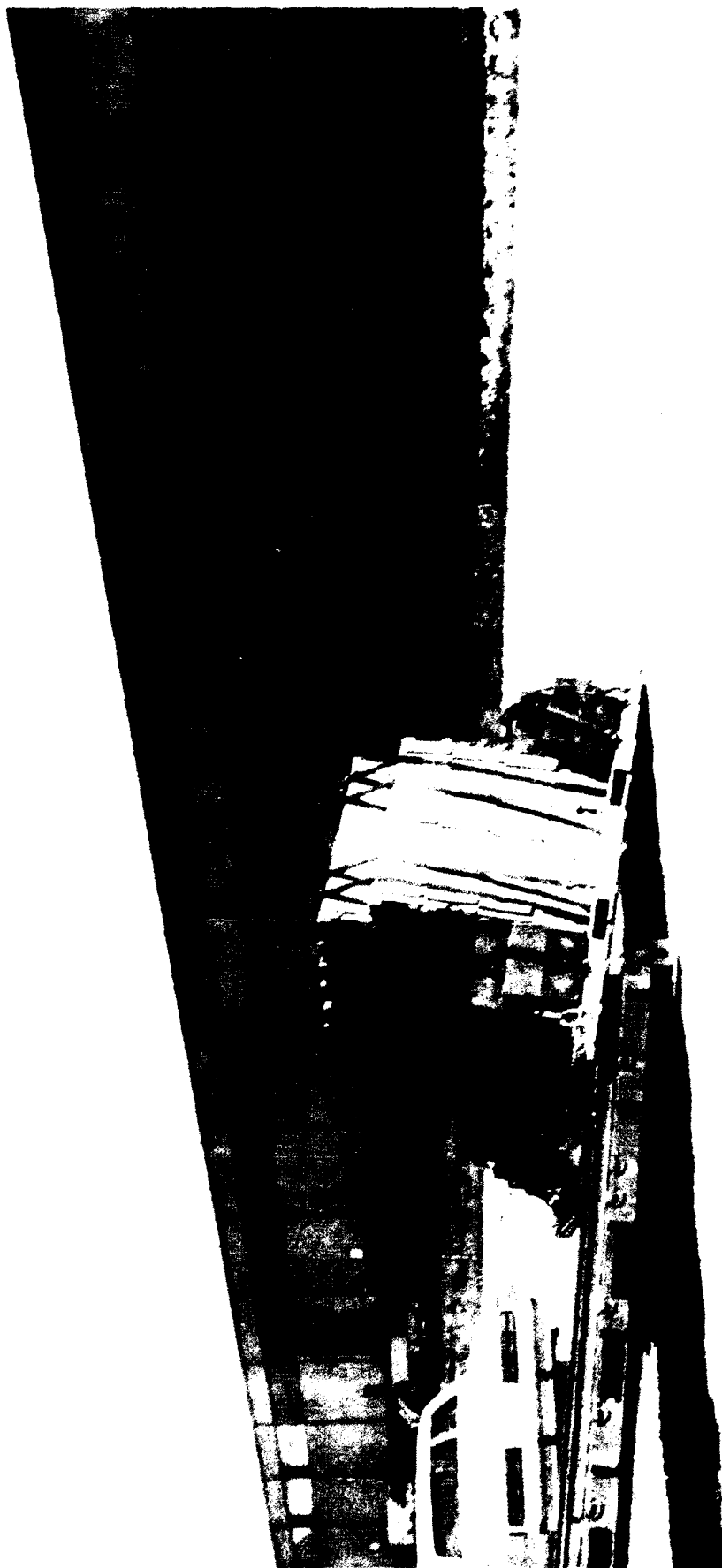
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Photo No. AO317-SCN-91-262-4119. This photograph shows one of the outer bottom two 30mm ammo containers that started to ride up on the tiedown anchors during the washboard course.



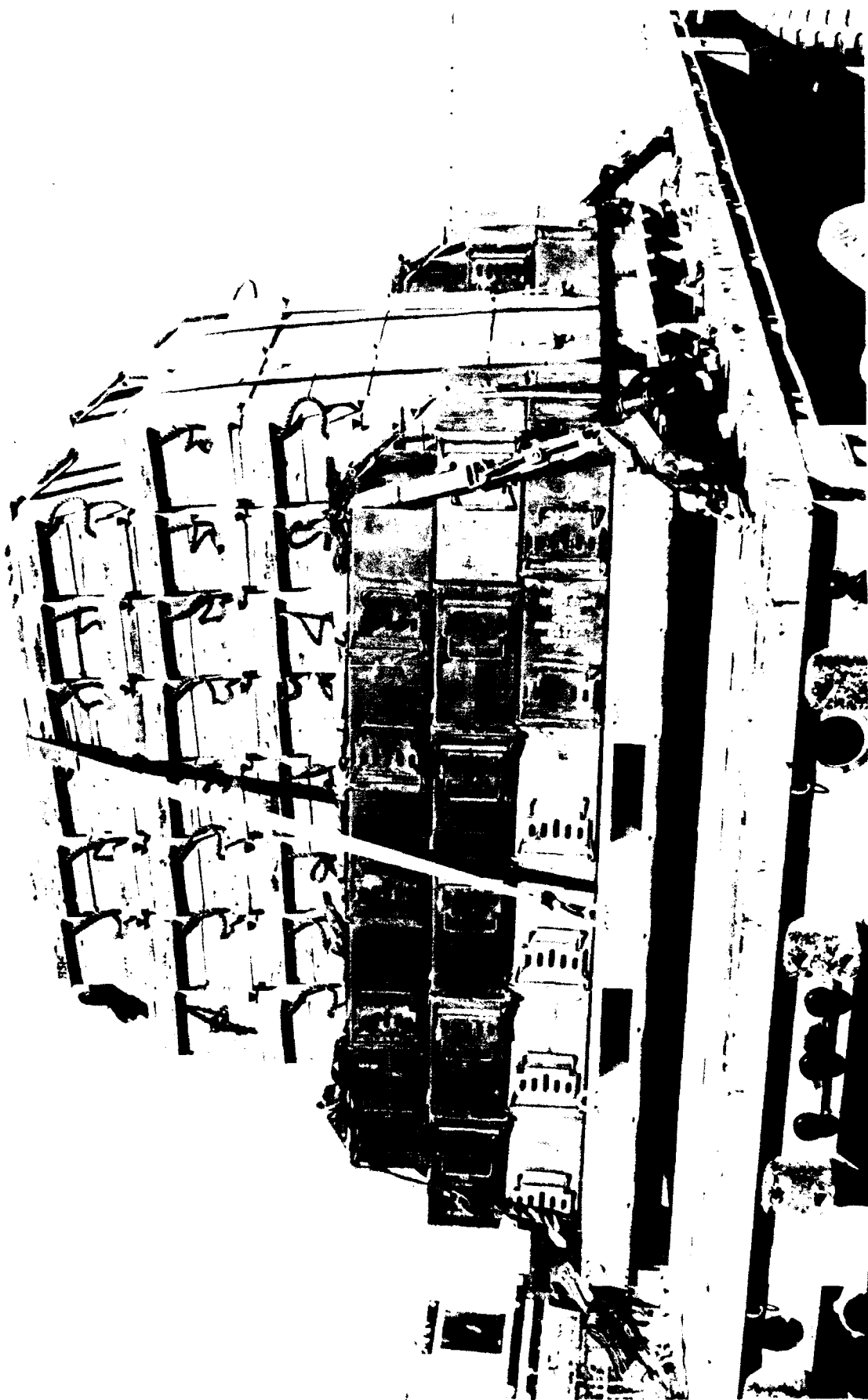
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Photo No. AO317-SPN-91-345-4072. This photograph shows Apache Load III during sling testing.



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Photo No. AO317-SPN-91-345-4080. This photograph shows Apache Load III striking the ground during the 10 degree incline unloading test.



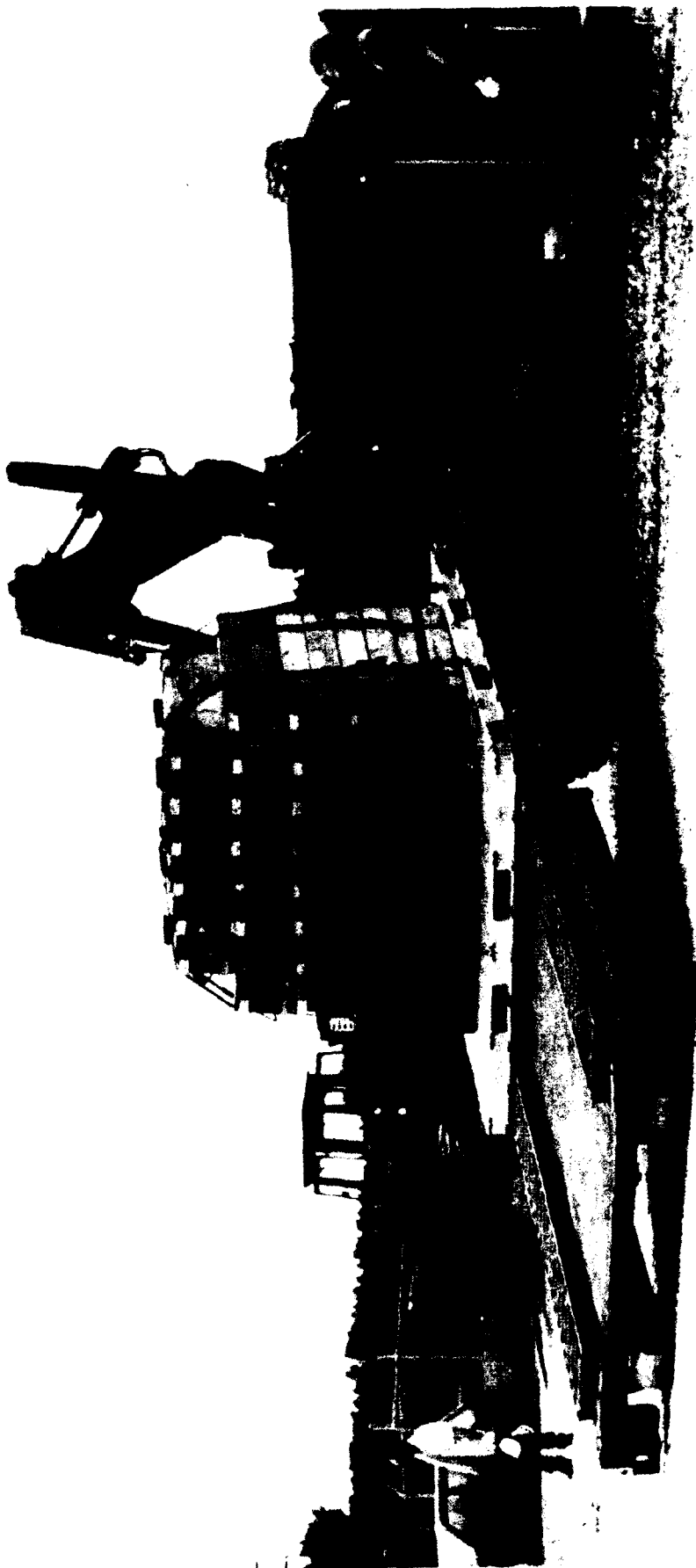
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Photo No. AO317-SCN-91-262-4132. This photograph shows Apache Load III on the M871 trailer prior to road hazard testing.



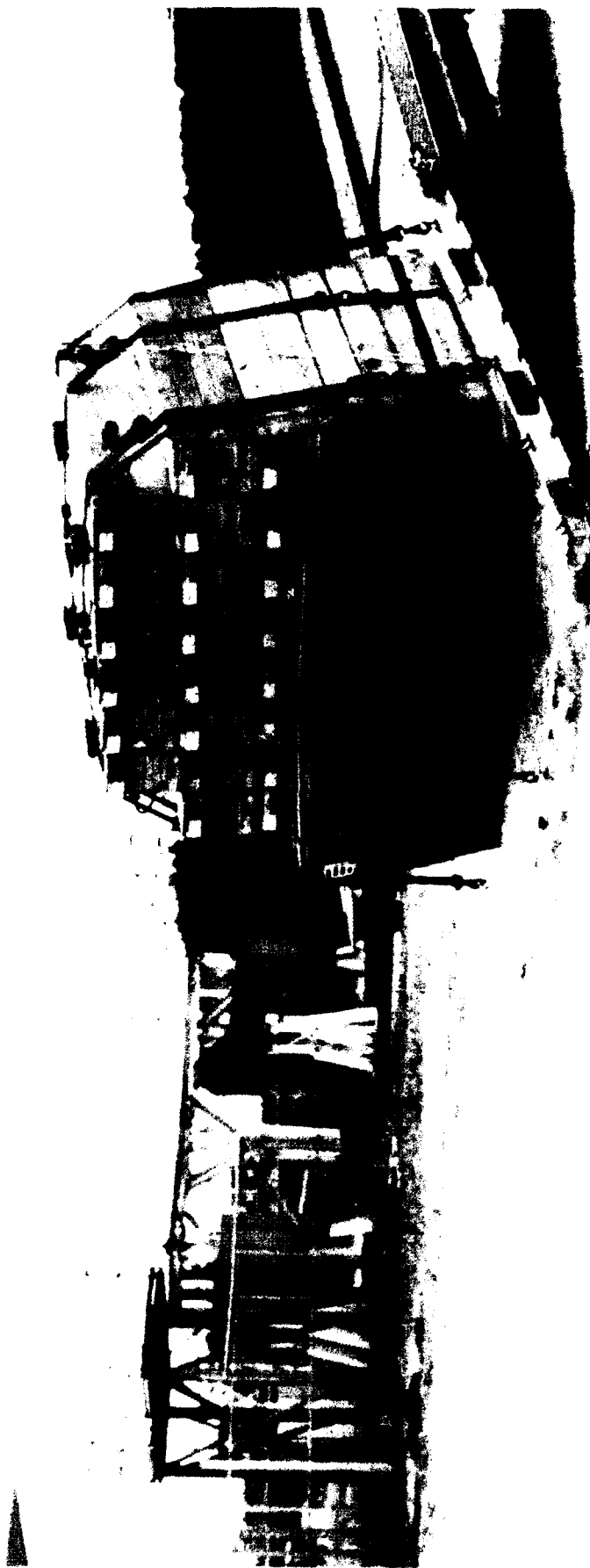
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Photo No. AO317-SPN-91-345-4054. This photograph shows Cobra Load II during sling testing.

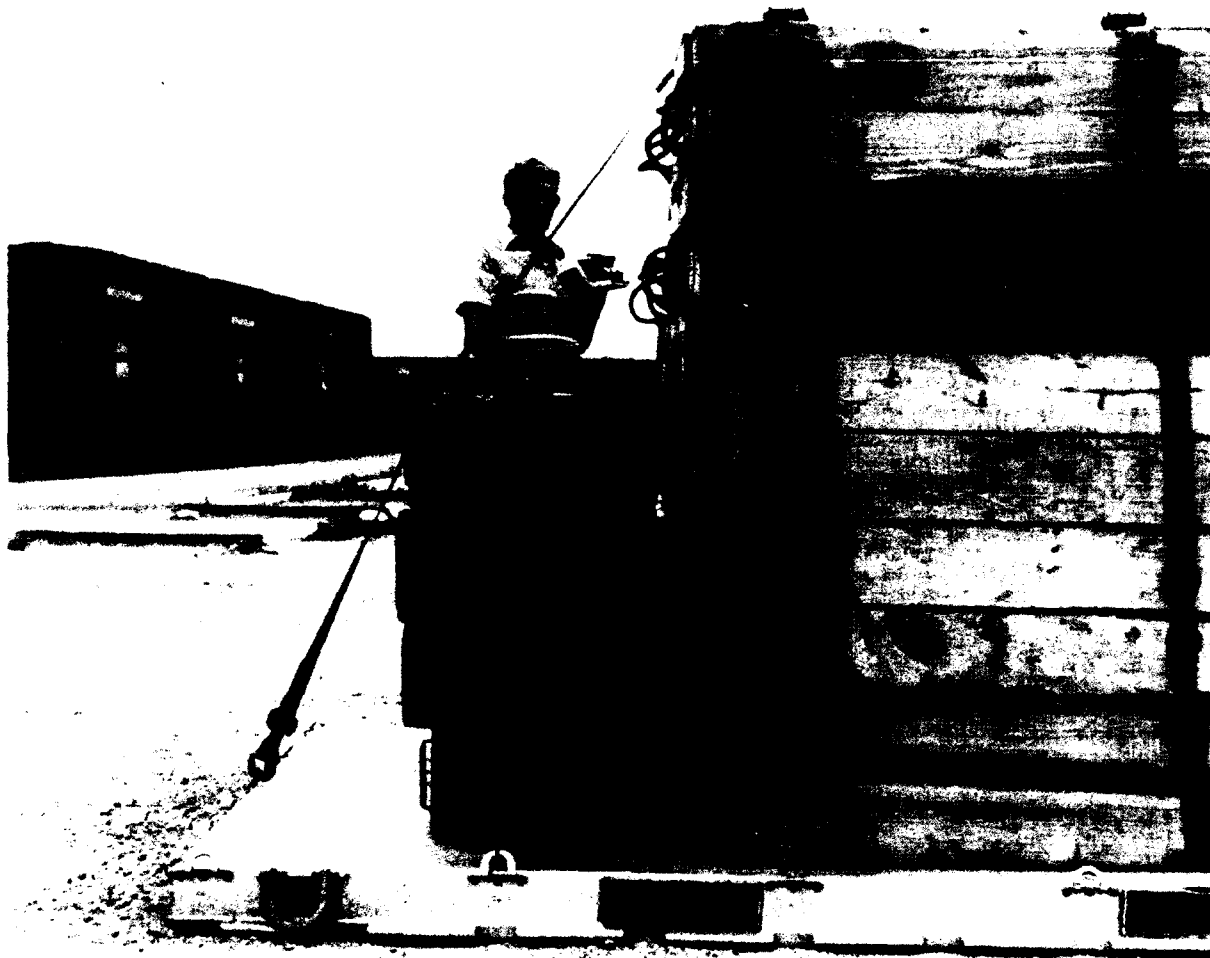


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Photo No. AO317-SPN-91-345-4058. This photograph shows Cobra Load II on the PLS flatrack at the 10 degree test angle.

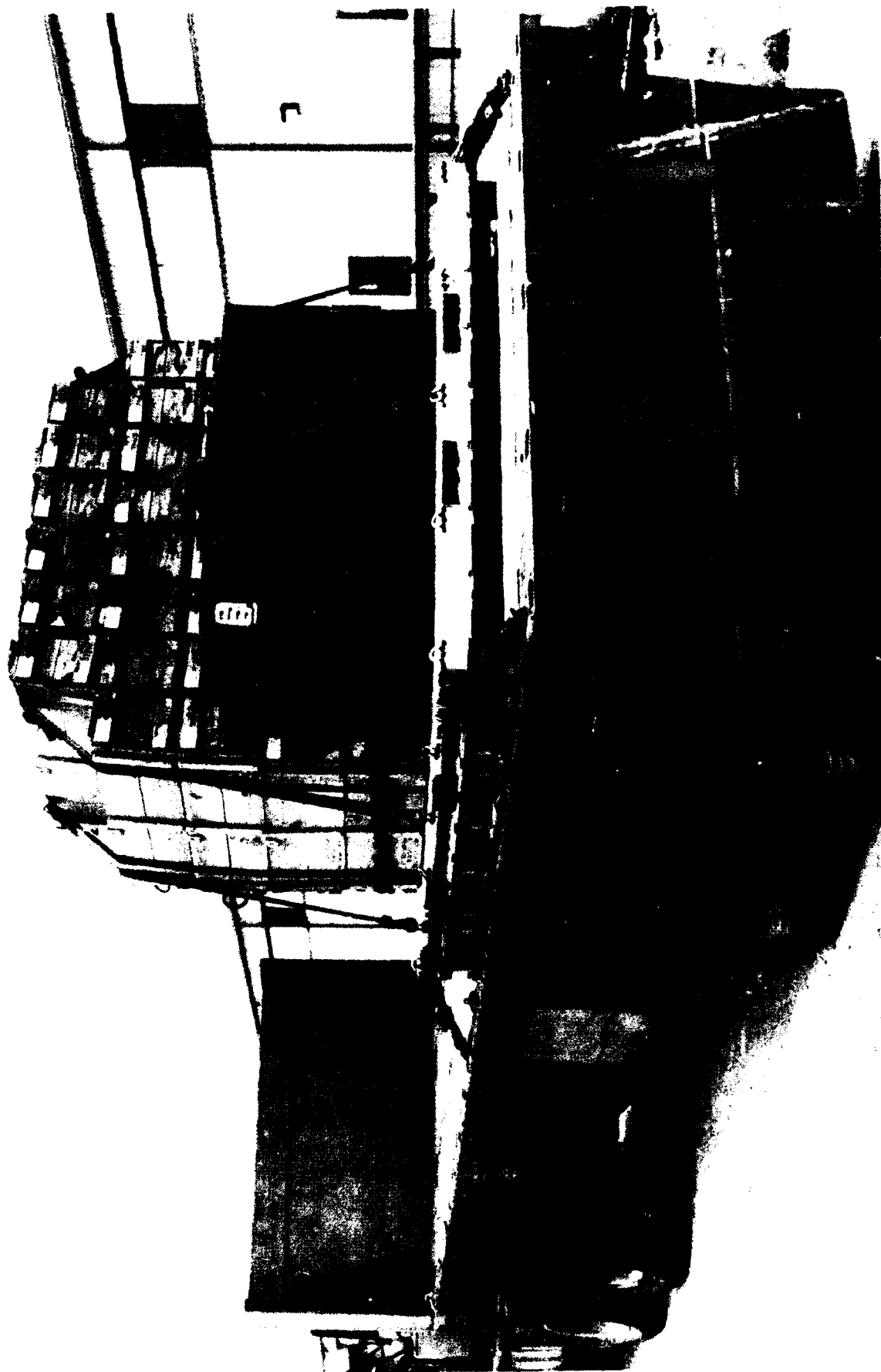


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Photo No. AO317-SPN-91-345-4059. This photograph shows Cobra Load II striking the ground during the 10 degree incline unloading test.		



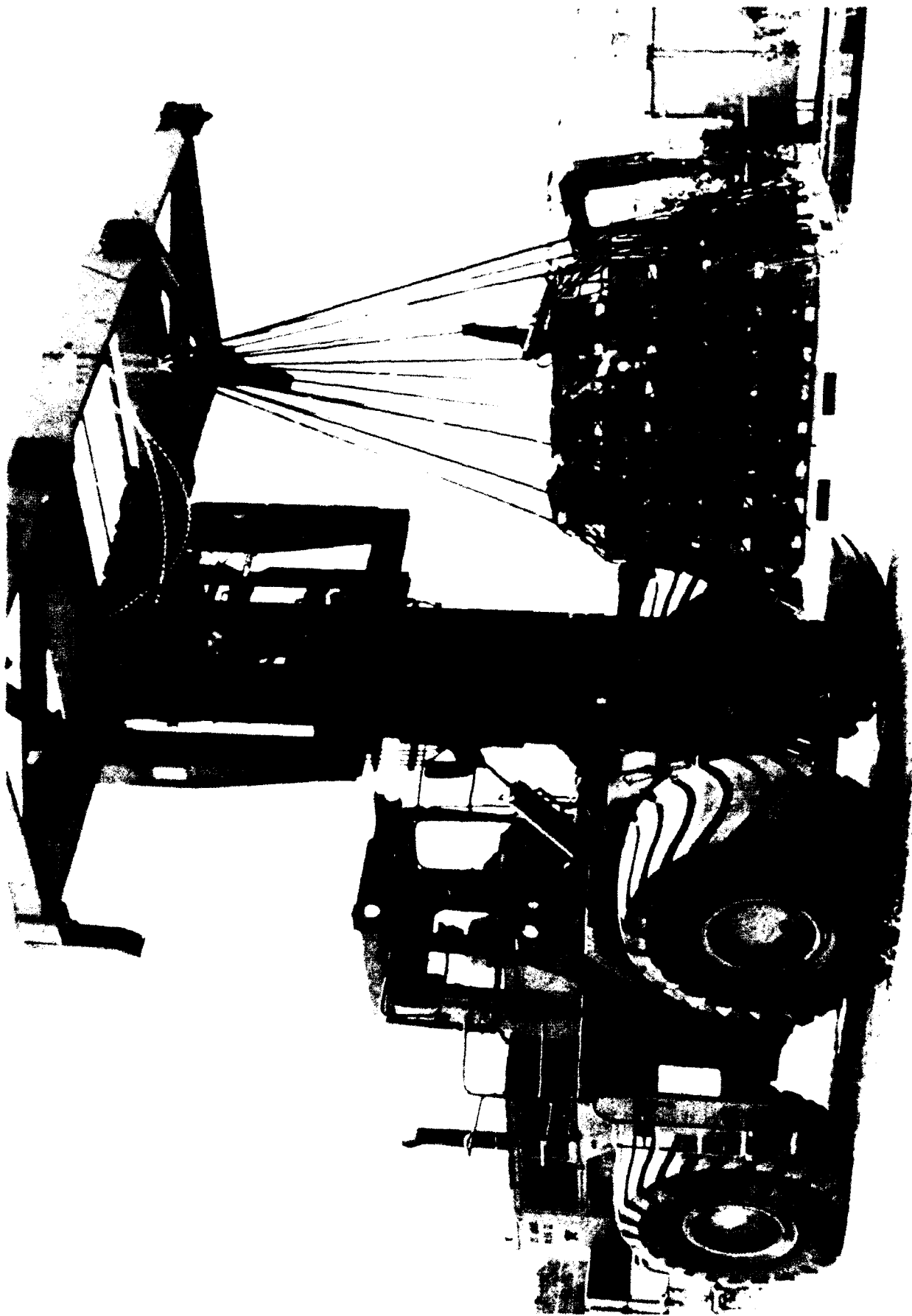
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Photo No. AO317-SPN-91-345-4060. This photograph shows the container shifting that took place as a result of the 10 degree incline unloading test.
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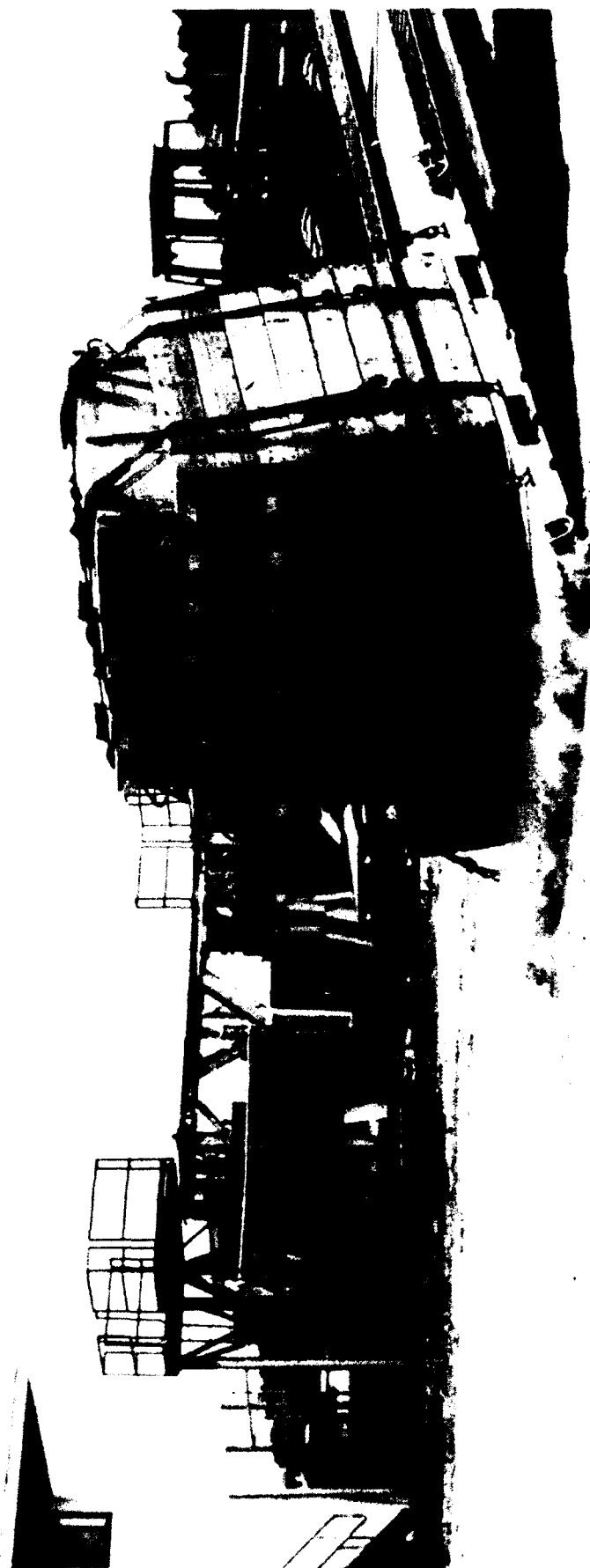
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Photo No. AO317-SPN-91-345-4063. This photograph shows Cobra Load II on the M871 trailer prior to road hazard testing.



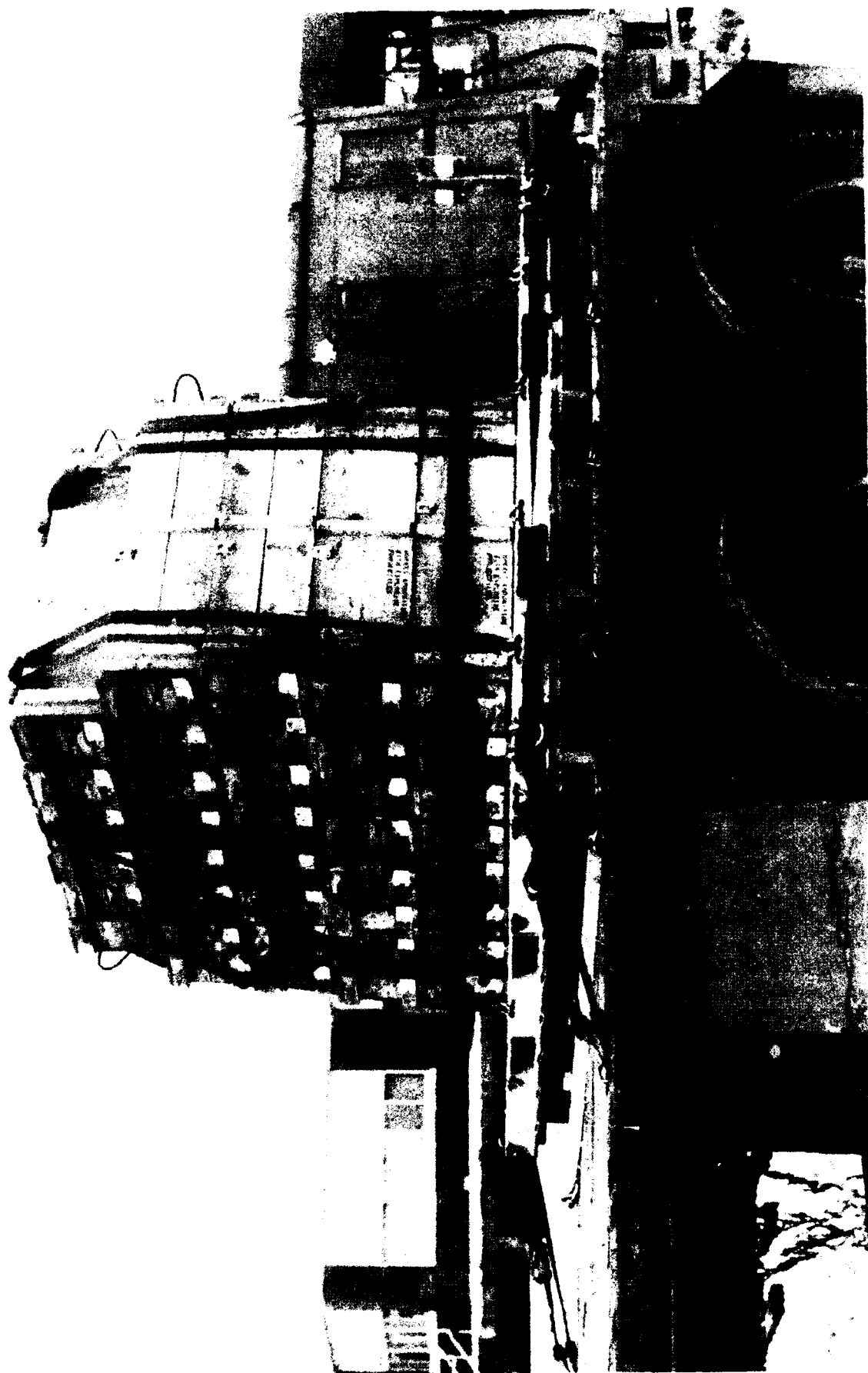
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. AO317-SCN-91-262-4094. This photograph shows Cobra Load III during sling testing.



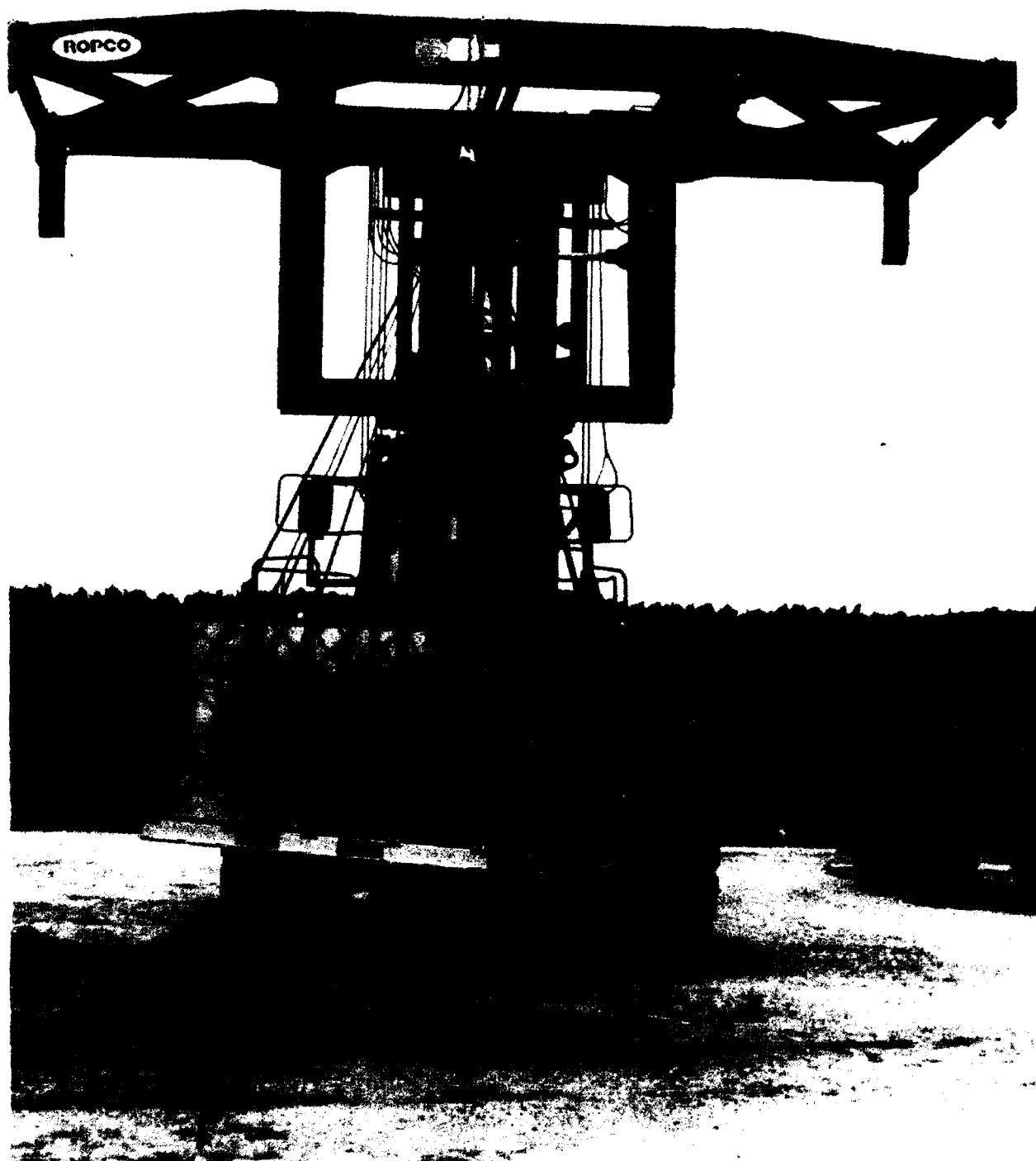
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
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Photo No. AO317-SCN-91-262-4086. This photograph shows Cobra Load III striking the ground during the 10 degree incline unloading test.
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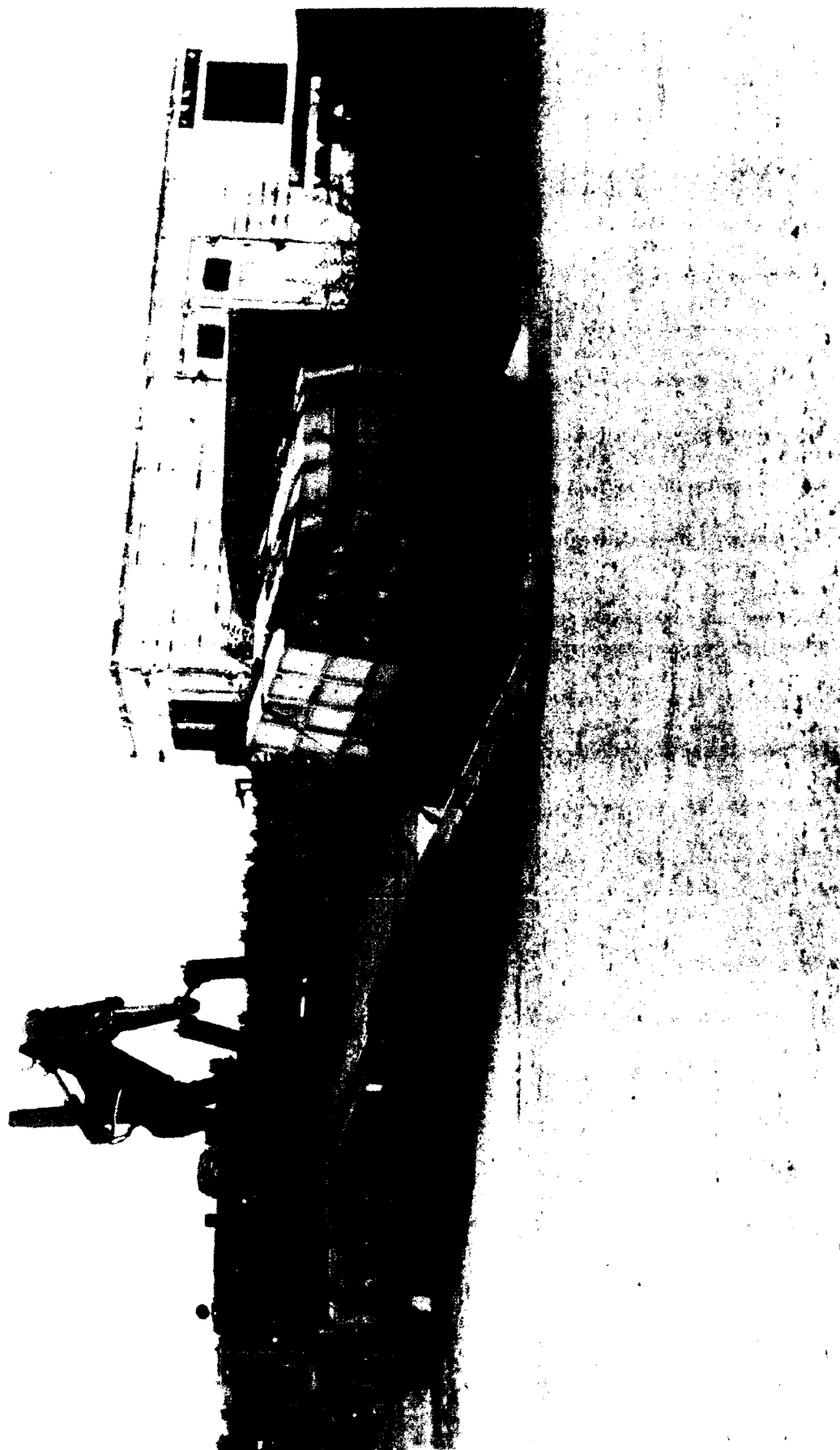
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Photo No. AO317-SPN-91-262-4025. This photograph shows Cobra Load III on the M871 trailer prior to road hazard testing.



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Photo No. AO317-SPN-91-262-4009. This photograph shows Cobra Load I during sling testing.



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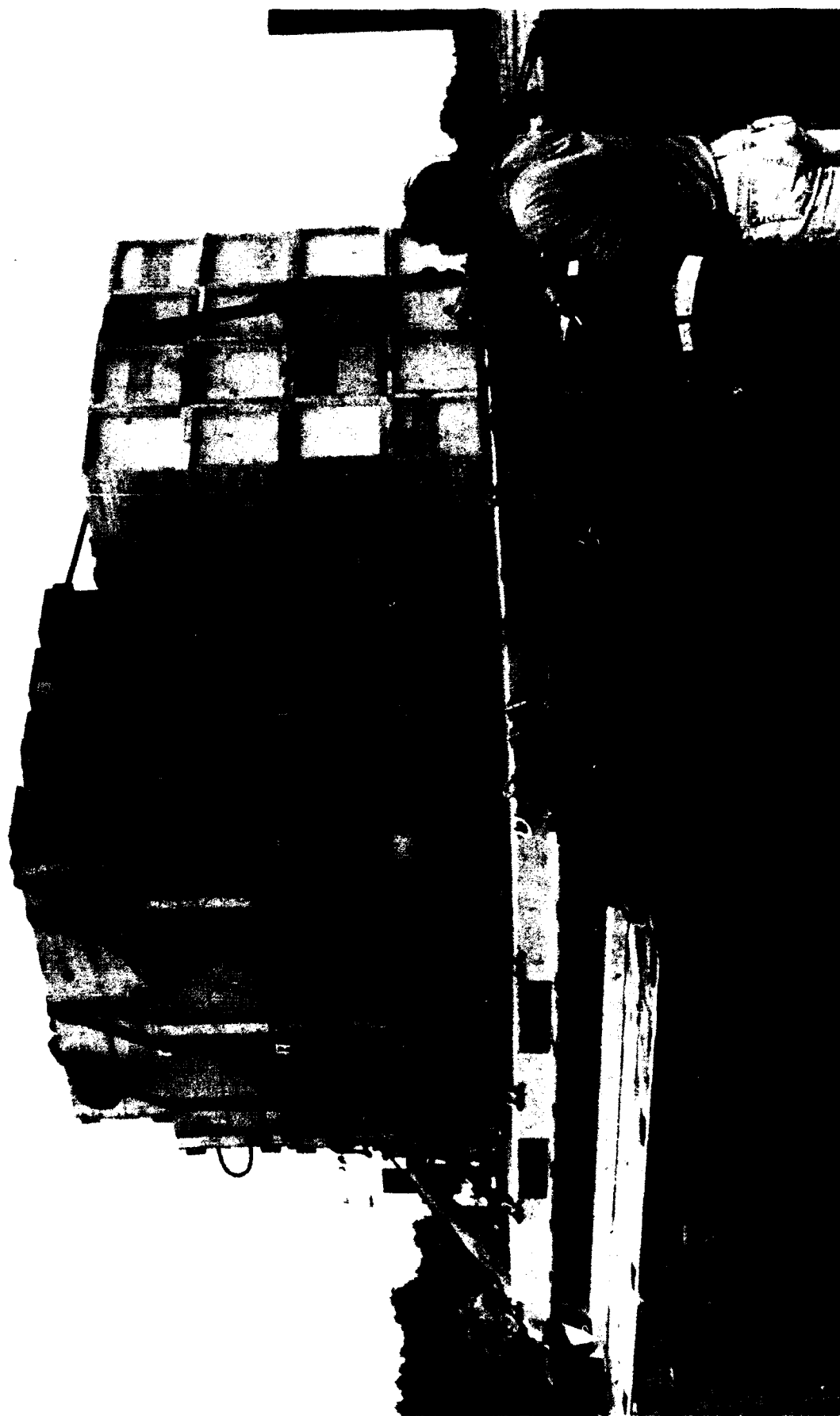
Photo No. AO317-SPN-91-262-4012. This photograph shows Cobra Load 1 striking the ground during the 10 degree incline impact test. Note: The 2.75-inch rocket container in the top row of containers that failed during the test.



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Photo No. AO317-SPN-91-262-4014. This photograph shows Cobra Load I after the 10 degree incline impact test.

Note: The damaged 2.75-inch rocket container.



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. AO317-SPN-91-262-4017. This photograph shows Cobra Load I on the M871 trailer prior to road hazard testing.



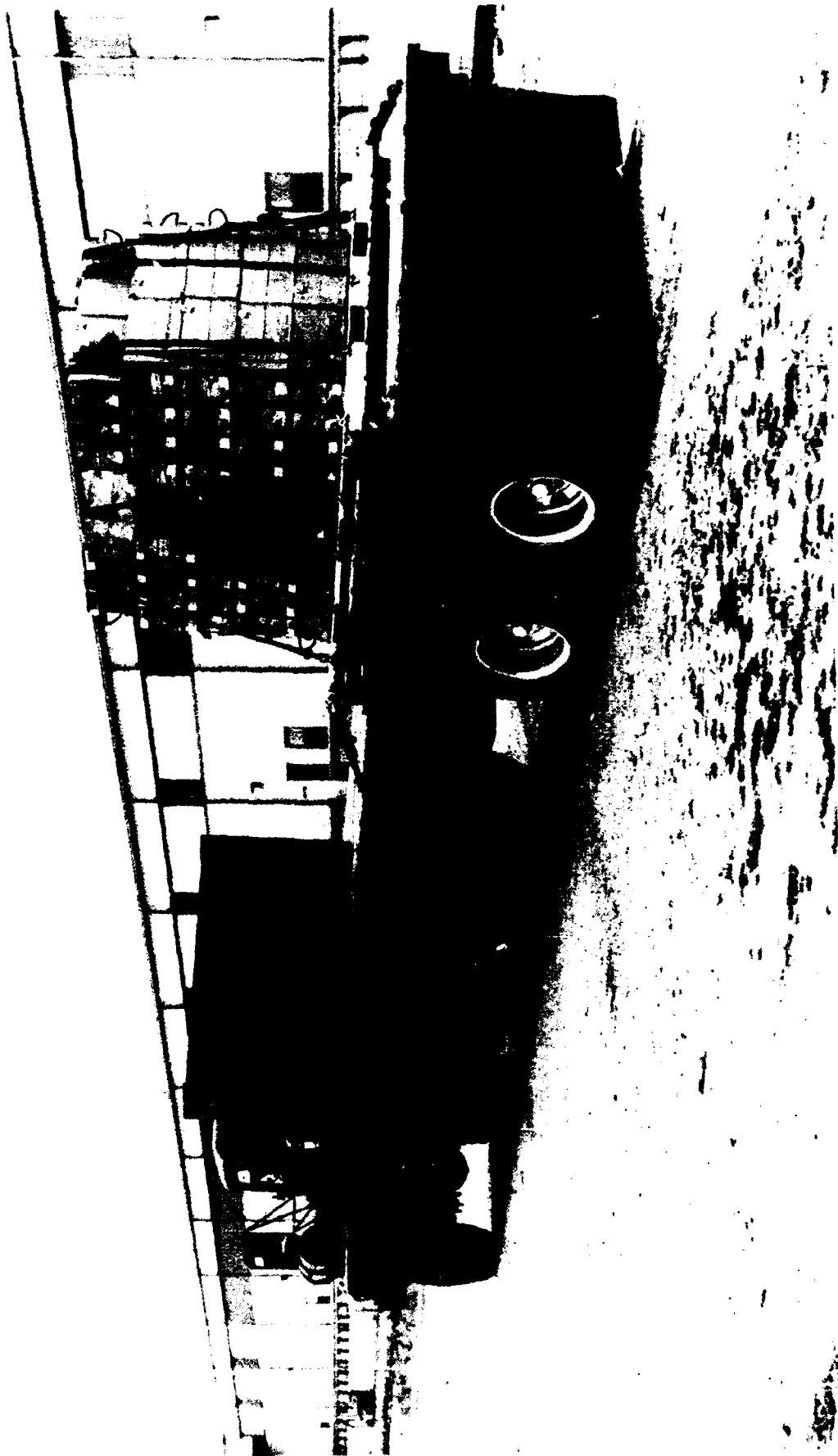
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Photo No. AO317-SPN-92-70-922. This photograph shows the modified Cobra Load II during sling testing.



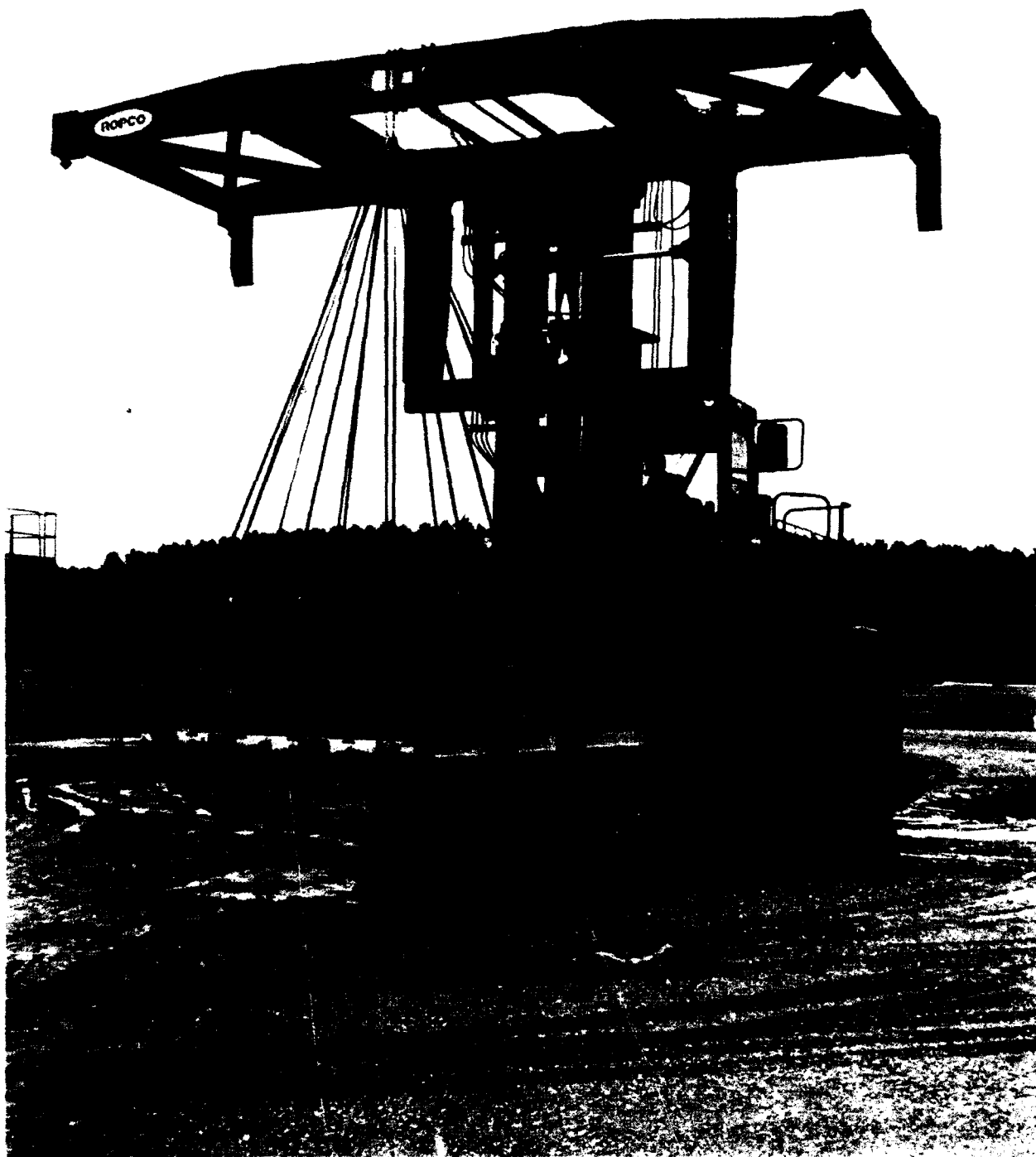
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Photo No. AO317-SPN-92-70-934. This photograph shows the modified Cobra Load II striking the ground during the 10 degree incline impact test.



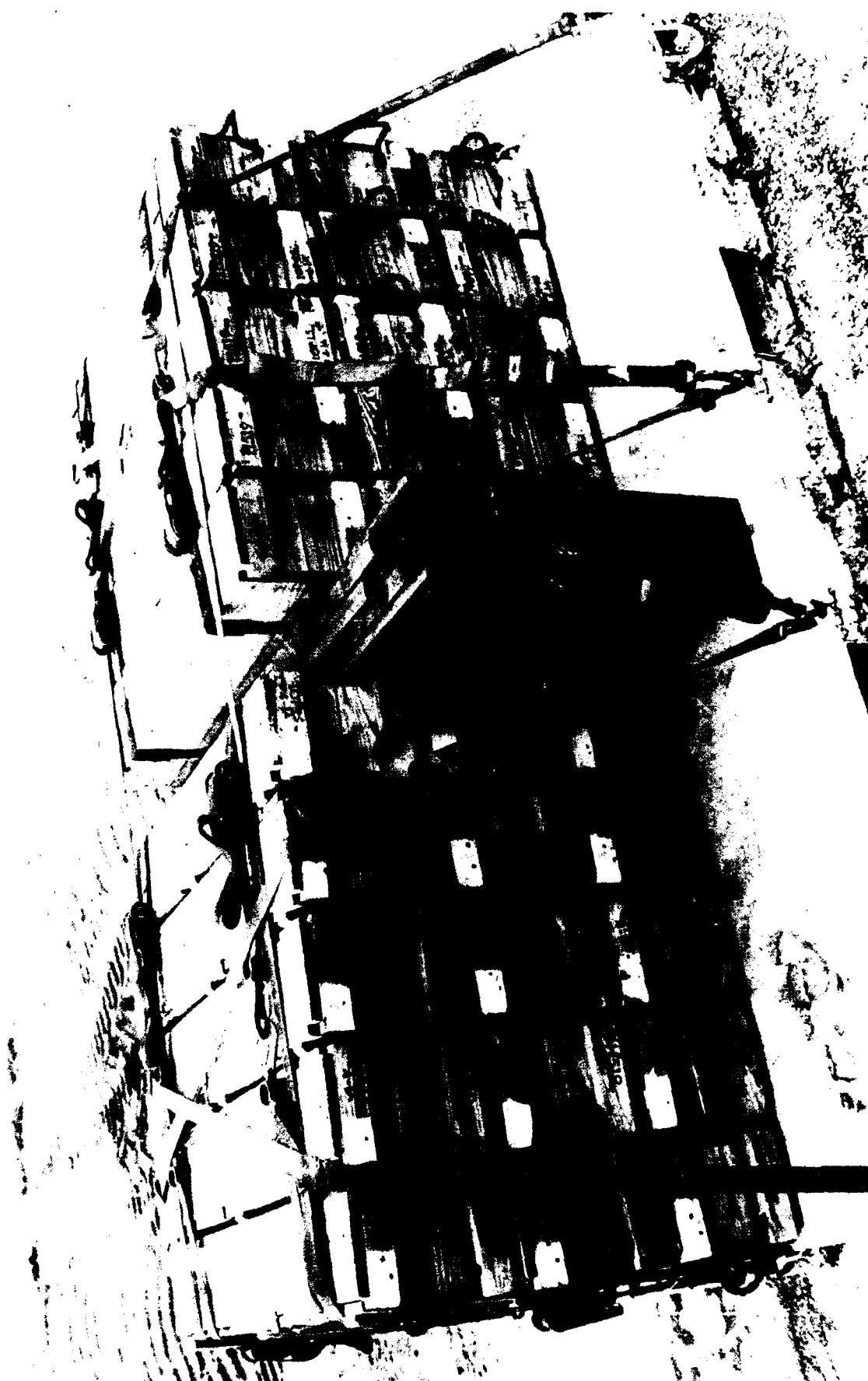
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Photo No. AO317-SPN-92-70-936. This photograph shows the modified Cobra Load II on the M871 trailer prior to road hazard testing.



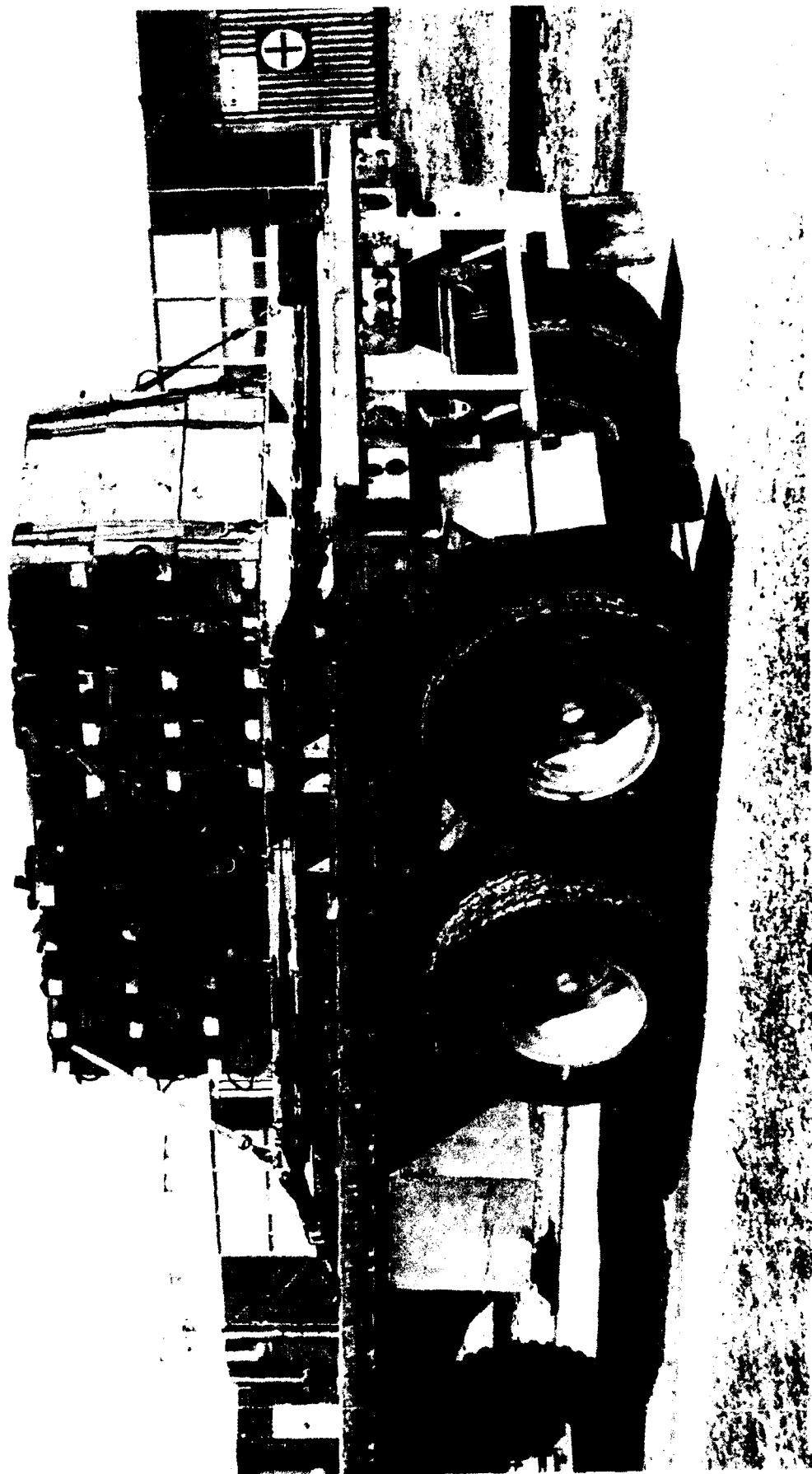
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
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Photo No. AO317-SCN-92-110-1262. This photograph shows Comanche Load II during sling testing.		
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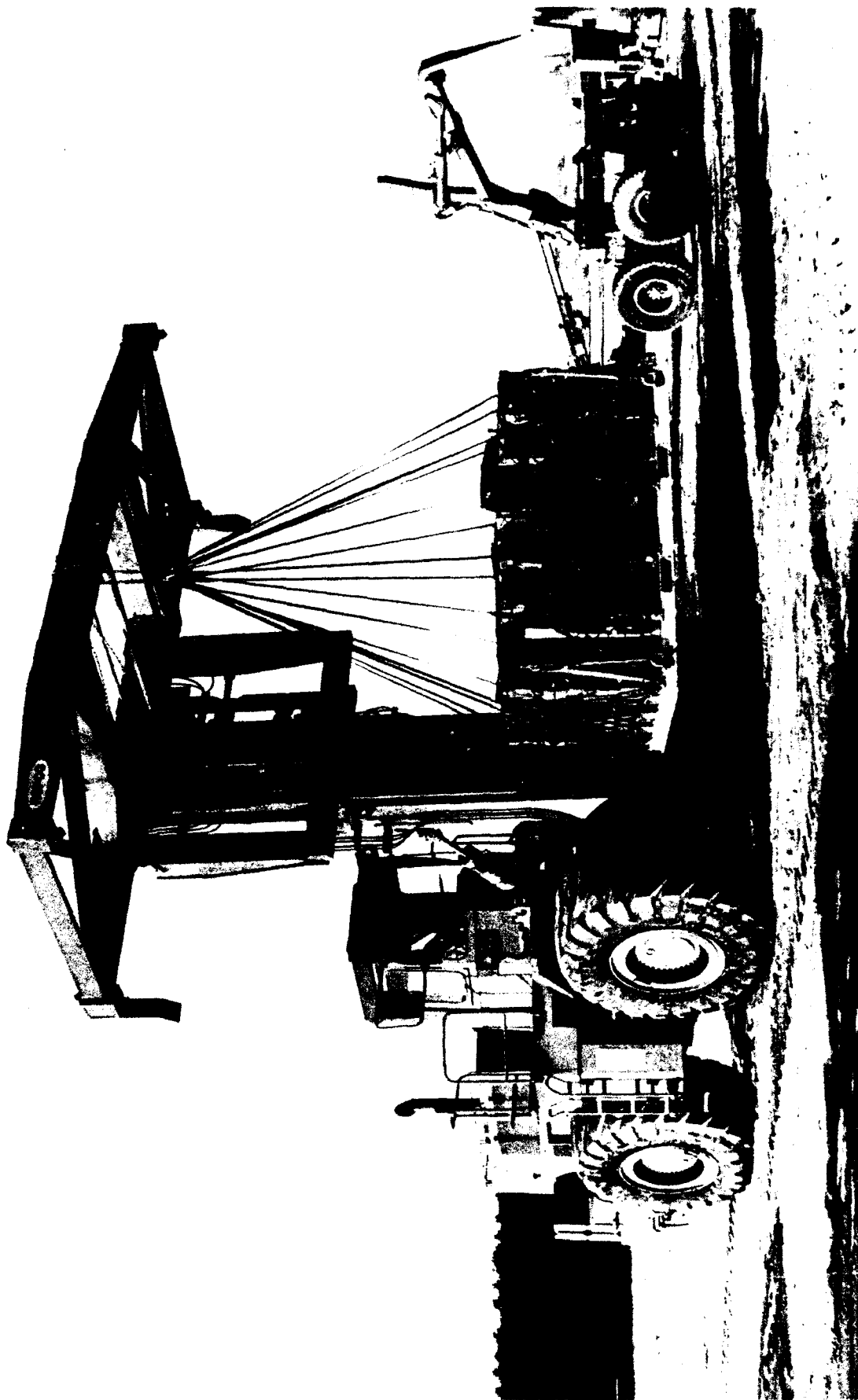
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. AO317-SCN-92-110-1264. This photograph shows Comanche Load II after the 10 degree incline impact test.



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Photo No. AO317-SCN-92-110-1267. This photograph shows Comanche Load II on the M871 trailer prior to road hazard testing.



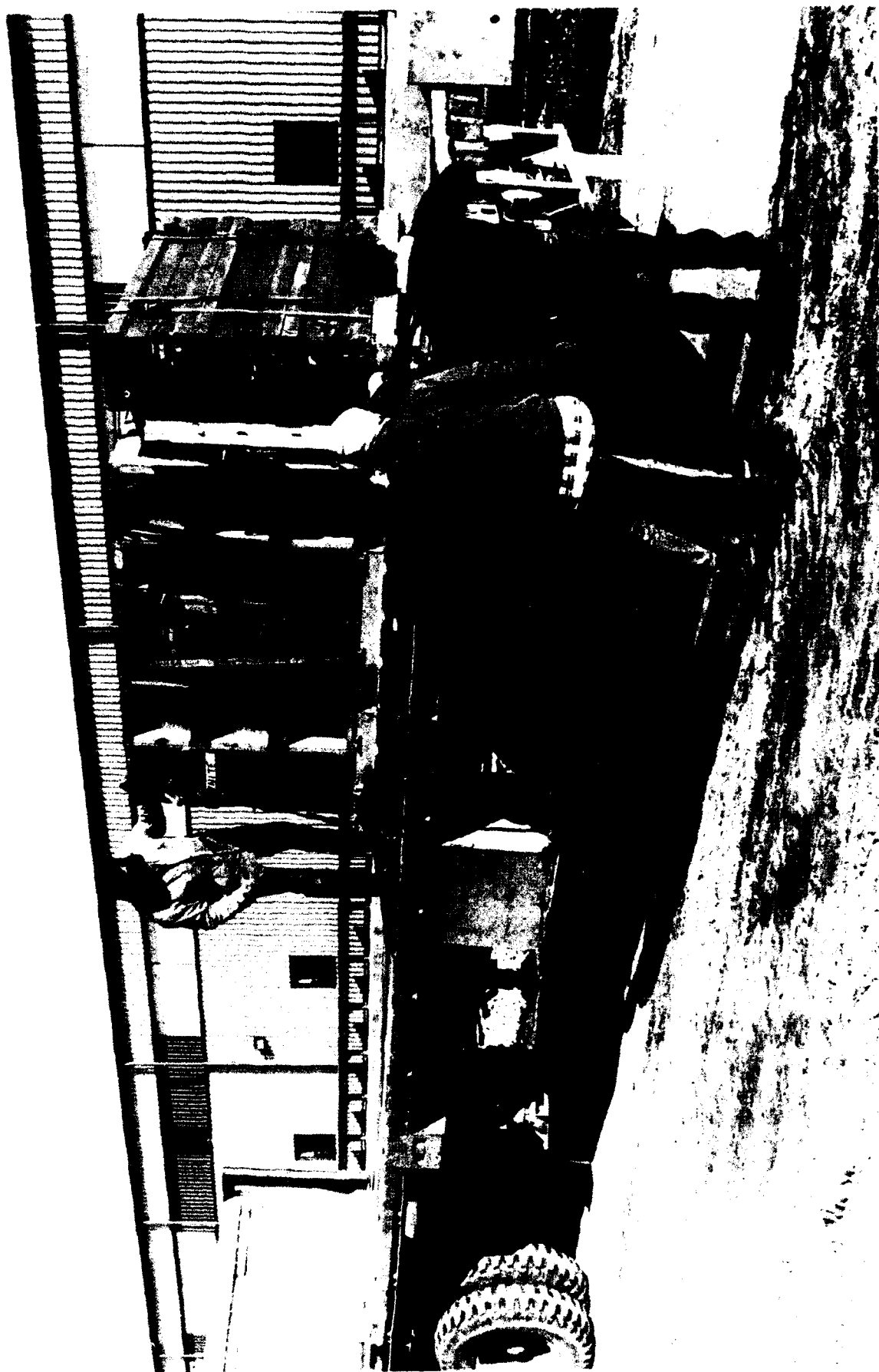
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. AO317-SCN-92-110-1253. This photograph shows Comanche Load I during sling testing.



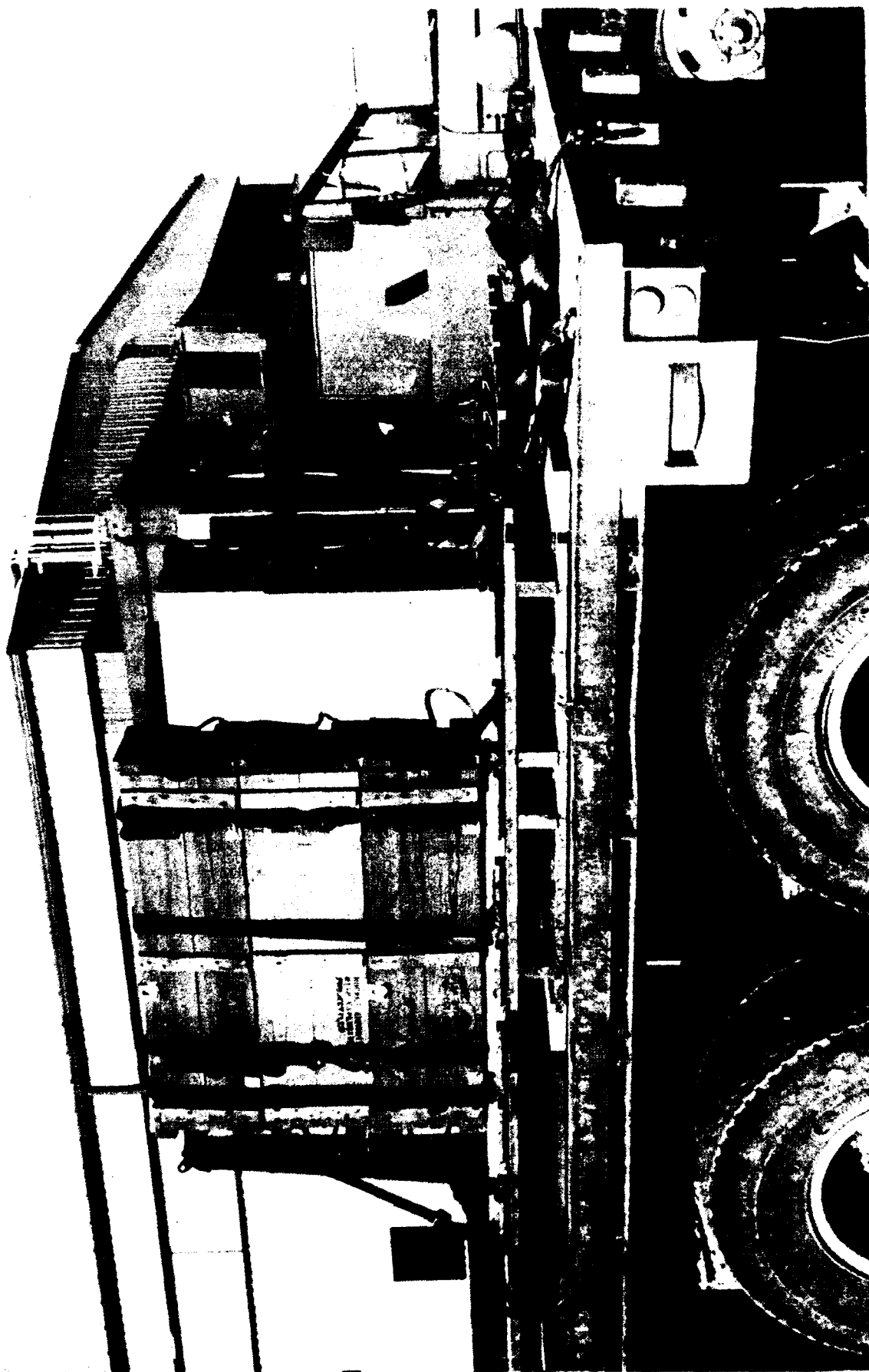
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. AO317-SCN-92-110-1257. This photograph shows Comanche Load 1 striking the ground during the 10 degree incline unloading test.



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Photo No. AO317-SCN-92-110-1260. This photograph shows Comanche Load I being loaded onto the M871 trailer prior to road hazard testing.



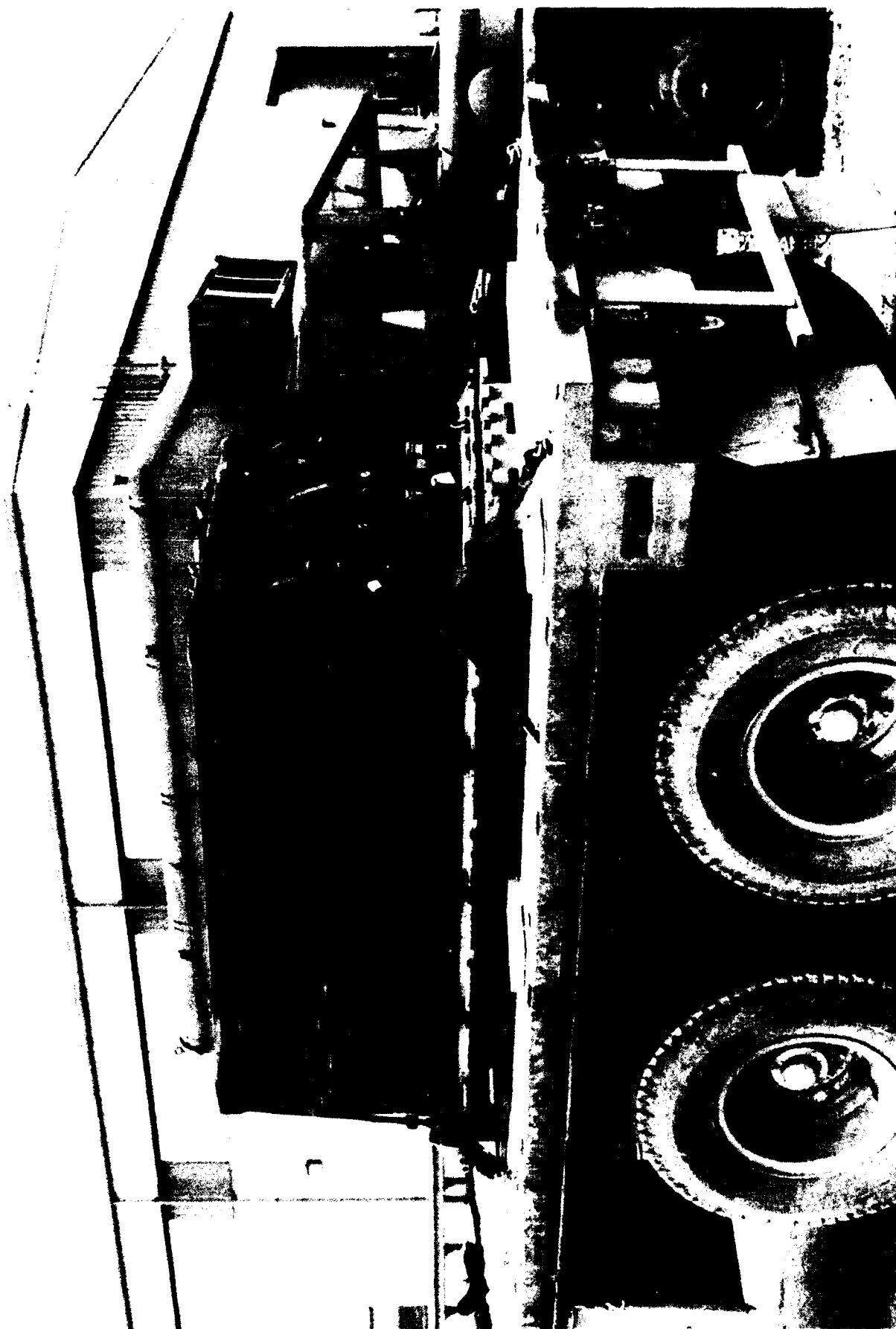
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. AO317-SPN-92-110-1294. This photograph shows Kiowa Load I on the M871 trailer prior to road hazard testing.



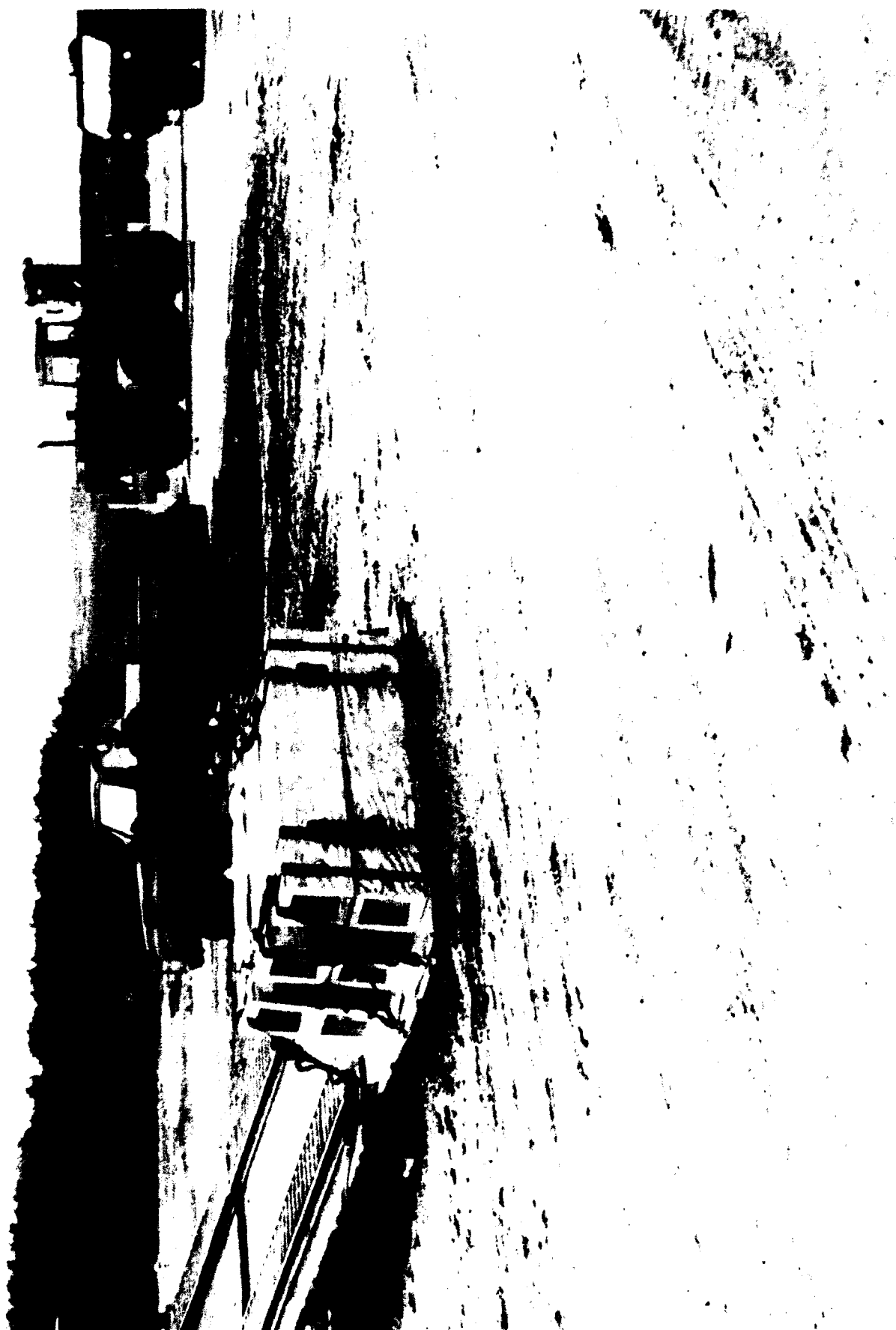
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
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Photo No. AO317-SPN-92-110-1327. This photograph shows Kiowa Load II striking the ground during the 10 degree incline unloading test.



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Photo No. AO317-SPN-92-110-1332. This photograph shows Kiowa Load II on the M871 trailer prior to road hazard testing.



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. AO317-SPN-92-110-1326. This photograph shows Kiowa Load III striking the ground during the 10 degree incline unloading test.



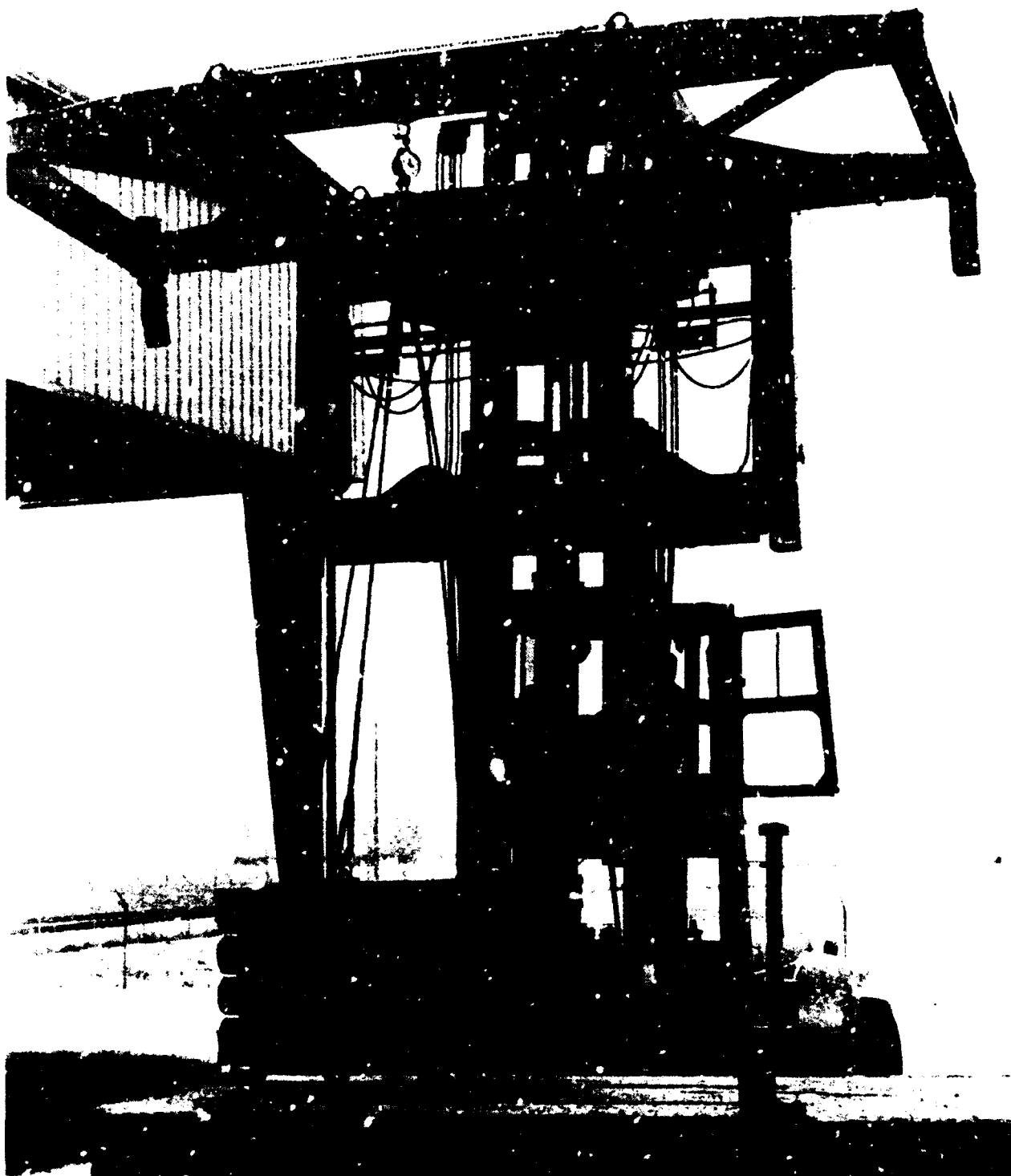
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. AO317-SPN-92-110-1338. This photograph shows Kiowa Load III on the M871 trailer prior to road hazard testing.



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Photo No. AO317-SPN-92-110-1337. This photograph shows the failure of the bottom of the half-size 463L pallet.



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Photo No. AO317-SPN-92-110-1343. This photograph shows the sling test that was performed on the pallet of 2.75-inch Hydra 70 rockets.
